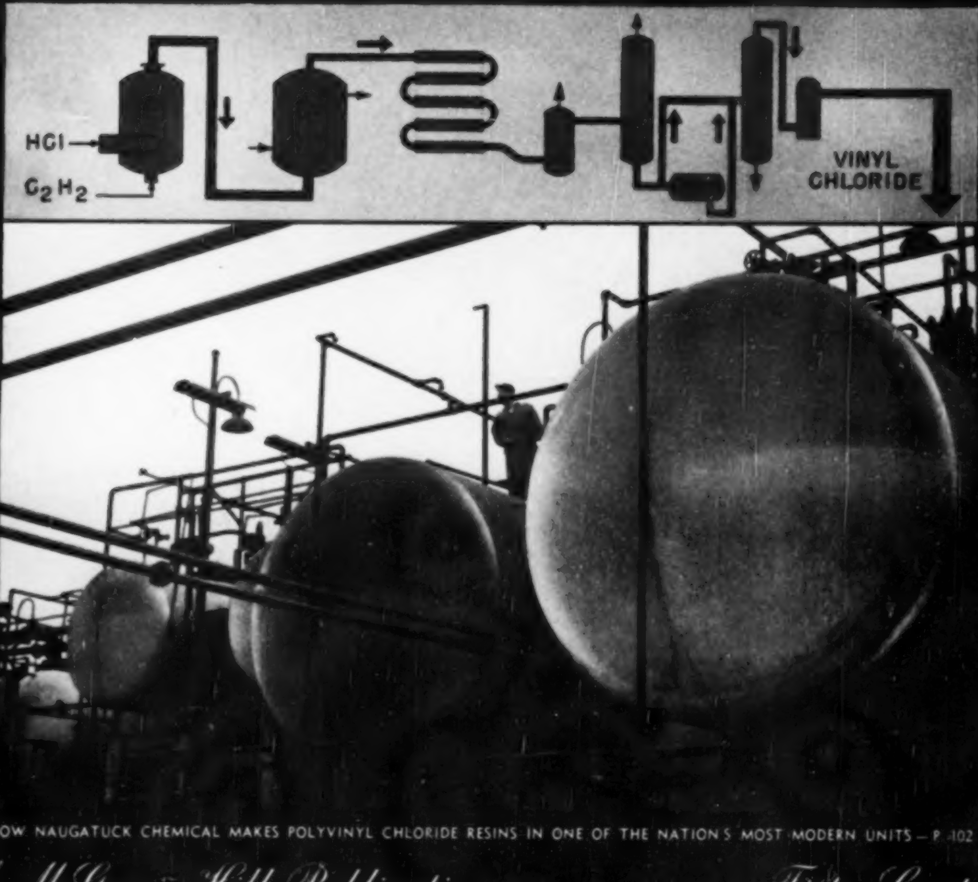
DECEMBER 1950

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING



HOW NAUGATUCK CHEMICAL MAKES POLYVINYL CHLORIDE RESINS IN ONE OF THE NATION'S MOST MODERN UNITS — P. 102

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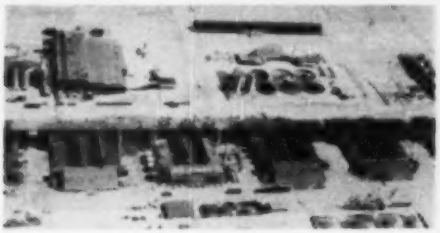

Plant at Henderson Expanding

Western Electrochemical Co., which moved its headquarters this year from Los Angeles to San Francisco, will increase the production of chlorate and perchlorate chemicals in its plant at Henderson, Nev., by next spring and will also begin the manufacture of battery-grade manganese dioxide. The expansion is expected to amount to several millions, and will mean some increase in the present operating staff of about 150 persons. The expansion was made possible by the acquisition of additional electric power from the Colorado River Commission. The company is doing most of its engineering design and construction.

Decision to begin the production of manganese dioxide was based on expanding requirements by the U. S. Signal Corps and private battery manufacturers. The process of making the battery-grade oxide from low-grade manganese ores is called the Schumacher process and was carried through the pilot plant stage in the company's research laboratories near Los Angeles, where J. C. Schumacher is director of research. Production is scheduled to begin in February at Henderson, where Fred Gibson is general manager.

Western Electrochemical is already the world's largest producer of chlorate and perchlorate chemicals, and manufactures sodium chlorate, potassium chlorate, potassium perchlorate, ammonium perchlorate and manganese sulphate at Henderson. The expansion program was decided upon in view of increasing interest in chlorate and perchlorate chemicals as fuel components for military planes and projectiles. Chlorate production will be expanded first, 202 additional electrolytic cells being used for this purpose.

More Phenolic Resins for Northwest

A large expansion in the manufacture of phenolic resins in the Pacific Northwest for use by the growing plywood industry is expected to become effective in February when Reichhold Chemicals, Inc., completes a plant at Vancouver, B. C. Capacity is 75 tons per 24-hr. operating day. The plant, which will probably employ six or more persons, will be operated as the western division of Reichhold Chemicals of Canada, Ltd., and will be under the jurisdiction of T. S. Hodgins, Pacific Northwest manager for Reichhold Chemicals at Seattle.

Plywood mills in British Columbia are at present supplied from Reichhold's Seattle plant, but in view of increasing requirements it was decided that construction of a plant at Vancouver would offer the most convenient source of supply. One 5,000-gal. kettle will be installed.

We're Moving

Starting in January you will find your *PPI* section just inside the back cover of the magazine.

Nopco Opening Two Plants in Spring

Two closely adjacent plants at Richmond, Calif., are being fitted with equipment by Nopco Chemical Co. to go into the manufacture of palmitates, stearates and a line of specialties and agricultural products next spring.

On South 14th St. the company's four-year old plant is being converted by Metasap Chemical Co., a wholly-owned subsidiary, for the production of stearates and palmitates of aluminum, zinc (both commercial and cosmetic grades), calcium, barium, lead and magnesium, such products being intended for use in the manufacture of greases, plastics, rubber, ceramics, textiles and other products. This plant was formerly occupied by Rare-Galen, Inc., for manufacture of pharmaceuticals before the business of Rare-Galen was sold by Nopco earlier in the year to White Laboratories at Newark, N. J.

The plant on South 10th St., which Nopco formerly operated to produce vitamin oil products, is being fitted by the company to produce such products and sulphonated oils, fatty esters, fatty amides and glycerides for use in pulp and paper, defoaming agents, detergents, polish bases and textiles.

Activities of Nopco's Pacific Division are under the management of P. S. Brown, vice president, assisted by Harold A. Swanson as general sales manager. Administrative offices for both plants are at the 14th St. plant and office building. Production manager for both plants is Jay Wolfson, who had been in charge of production at Nopco's Harrison, N. J., plant since 1929.

Benzene to Come From Hawaii

A relatively small but welcome contribution of benzene to the short Pacific Coast supplies should be moving from Hawaii either this month or early in January. Honolulu Gas Co. will begin production of benzene at the rate of about 1 million gallons per year when a $225,000 plant being built for the company by Fish Engineering Co., Houston, Tex., is completed. Most of the production will be taken by a chemical manufacturing firm in San Francisco. Pacific Refiners, a new subsidiary of the gas company, will act as distributor for the product.

Benzene will be manufactured by thermal cracking of residuum and gas oil in Jones type generators. The raw material oils will be supplied by Pacific Refiners, which is importing petroleum oils from the Pacific Coast. Con-

sideration is being given to separation and sale of toluene and xylene that will be produced concurrently with the benzene.

Ammonia Plant Slated for Tacoma

Hooker Electrochemical Co. expects to complete early in 1952 at Tacoma the first anhydrous ammonia plant in the Pacific Northwest. The installation, which will be built at the company's present plant that manufactures caustic soda and hydrogen, is expected to cost around $2 million. The company has completed the replacement of older caustic cells by the new Type S-3 cells to enlarge the capacity materially. Hydrogen for the ammonia plant will be byproduct hydrogen from the caustic-chlorine operation.

Fatty Acids Plant Changes Hands

Vegetable Oil Products Co., which operates a vegetable oil plant at Wilmington, Calif., has bought the fatty acids plant and related facilities at Los Angeles previously owned and operated by W. C. Hardesty Co. The Hardesty property is now known as the Vopcolene Division of Vegetable Oil Products Co., and acids and industrial oils previously marketed by Hardesty have been given the Vopcolene trade name. W. J. O'Connell, who directed the Hardesty plant, has been retained as plant manager.

It is understood that one reason for the purchase is that the Vegetable Oil Products operation produces byproduct materials of the type required by Hardesty. Some process improvements are likely to be made in the purchased plant, and additional products may be manufactured.

Opening for a Wood Treating Plant

The U. S. Department of the Interior is urging establishment by private industry of a wood-treating plant in Alaska, preferably near Anchorage or on the Kenai peninsula, near the source of Alaskan timber supplies. A large volume of wood preservative business is foreseen in the next few years. Cost of the plant would range from $75,000 to $250,000, depending on the type, according to K. J. Kadow, director of the Alaska field staff representing the Secretary of the Interior in Alaska.

Manganese Dioxide in Production

A new product, battery-grade manganese dioxide, has begun to be manufactured in the former government-owned plant at Salem, Ore., that Continental Chemical Co. leased earlier this year (*PPI*, May) and began the production of ammonium sulphate. Capacity production is expected to be at the rate of 200 tons per month. A. W. Metzger, plant manager, says that the product will be shipped to battery manufacturing companies that have contracts with the procurement division of the U. S. Signal Corps. Ore for the process is received at Salem from mines in northern California and in Nevada.

The company has not disclosed the process used in making the dioxide. However, late in 1949 Manganese Products Co., Seattle, was negotiating with the government for purchase of the Salem plant, with the intention of manufacturing manganese dioxide. The process that Manganese Products would have used involved the leaching of low-grade ore with sulphurous acid. The resulting solution of manganous sulphate and sulphuric acid, would then be treated with ammonia and agitated with air, resulting in the formation of hydrated manganese dioxide and concomitant ammonium sulphate. It is believed there is some similarity between this process and that used now at Salem.

Caustic and Chlorine by LST Boat

Early next year Hooker Electrochemical Co. is scheduled to begin using a converted LST boat to ship bulk caustic soda and chlorine from Tacoma to two new pulp mills in British Columbia. Victory Machinery Depot at Victoria, B. C., converted the ship for Griffiths Steamship Co., Ltd., which will handle the movement under contracts with Columbia Cellulose Co. and H. R. MacMillan Co., Export Division. Plans for the conversion were prepared by Carl J. Nordstrom, Seattle.

Shipments of the chemicals to the MacMillan plant at Nanaimo, B. C., should begin in January, with a round trip time of 60 hr. including loading and discharge. Shipments to the Columbia Cellulose plant at Prince Rupert, B. C., are scheduled for February, with a round trip time of eight days. Plans call for bimonthly service to both plants.

The barge is 277 ft. long with 50-ft. beam, and draws 9 ft. loaded to its capacity of 1,900 dwt. It is equipped with centrifugal pumps for loading and discharging the 50 percent caustic solution. The caustic solution will be carried below deck in six tanks having a total capacity of about 1,800 tons of solution.

Chlorine for Prince Rupert will be carried in two cylindrical tanks strapped to the deck. Capacity of the larger tank is 104 tons, and capacity of the smaller is 53 tons. Chlorine for Nanaimo will be carried in as many as 12 chlorine tank cars with a combined capacity of 600 tons.

A special method of discharging the two shipboard chlorine tanks had to be devised in view of the fact there is a 19-ft. tidal range at Prince Rupert. Griffiths developed an air discharge arrangement from the barge to shore receiving tanks. Chlorine will be displaced from the tanks through a flexible metal hose to the foot of a boom, then through a rigid pipe on the boom and then through another flexible hose ashore. Under this arrangement, stresses will be on the boom, which is attached to a counterweighted

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A-frame on the wharf, rather than on the hose. The boom will carry one air and two chlorine lines.

Oregon Air Pollution Bill Drafted

A comprehensive bill that would vest in the Oregon Sanitary Authority widespread powers to control existing and potential atmospheric pollution, including the power to pass on new industrial construction, is scheduled to go to the Oregon legislature in January. Copies of the preliminary draft of the proposal, prepared by a subcommittee of the governor's Committee on Natural Resources, were being circulated among private industries and municipalities in November in order to obtain reactions to the measure prior to possible changes that might be made in December. Litigation arising from charges that fumes from several industries in the state damaged certain farm crops is understood to have been a principal factor in the framing of such a measure.

The proposal would require that the governor appoint to membership in the authority a member to represent the manufacturing industries and a member to represent municipalities. The authority would receive extensive power to define objectionable degrees of pollution; establish a program for prevention, control and abatement of all existing and new sources of pollution; enter private or public property for inspection; hold hearings and issue orders that are subject to later judicial review on appeal.

One of the features of the measure is a provision which would empower the authority to "Examine and approve or disapprove plans and specifications for and to inspect the construction and operation of all equipment or processes known to be or believed capable of emitting air pollutants, including all systems for the removal of air contaminants prior to discharge into the outside atmosphere." The measure carries an appropriation of $109,400.

The measure requires that any air pollution standards established by political subdivisions of the state shall provide at least the minimum standards established by the Sanitary Authority.

The committee which drafted the bill is composed largely of men connected with state government agencies. It includes Chester K. Sterrett, manager of the industries department of the Portland Chamber of Commerce, who was designated to review statements on the proposed bill.

Expert Says Alberta Can Export Gas

At a special hearing held last month by the Petroleum and Natural Gas Conservation Board of Alberta, Canada, Dr. C. R. Hetherington, New York gas engineer, presented estimates to show that the province has sufficient natural gas to supply its own requirements for a long period and to export a large volume to the United States as well. This is the issue that has caused the board to withhold the grant of an export license for over a year.

Hetherington's views followed an estimate by Dr. A. W. Nauss, Calgary geologist, that Alberta's marketable reserves now total seven trillion cubic feet. Nauss had been requested to give his views by Westcoast Transmission Co., the firm regarded as one of the contenders most likely to obtain the export franchise.

Hetherington divided the marketable gas fields into three major segments. He then suggested that one, with a reserve of 2.8 trillion, be allocated to Calgary Gas Co.; another, with 1.8 trillion, to Edmonton Gas Co.; and the third, with 2.1 trillion, to Westcoast Transmission. Other smaller areas would be allocated to local needs. He testified that the segments allocated for the two gas companies would meet their needs for the next 50 years and that Westcoast Transmission's region would fill its export requirements for 30 years.

Magnesium Units Likely to Reopen

There was every prospect several weeks ago that two government plants built in the West during World War II for the manufacture of magnesium would be restored to operation. The Munitions Board has been interested in reopening the plants in view of the increasing need for magnesium, not only because of the acutely short supply of another light metal, aluminum, but because the even lighter magnesium makes it attractive as a construction material for guided missiles.

One plant is that which Permanente Metals Co., now Kaiser Aluminum and Chemicals Co., operated for the government at Manteca, Calif. The plant was originally rated at 20 million pounds of magnesium per year. It employed the Pidgeon ferrosilicon process, in which calcined dolomite is bricketted with ferrosilicon, the brickettes then being retorted to release the metal from the dolomite. The outlook was strong last month that Kaiser would get a contract to rehabilitate and operate the plant again. This would entail some rehabilitation work at the ferrosilicon plant at Permenente and some changes in the dolomite plant at Natividad.

The other western plant that formerly produced magnesium, also via ferrosilicon, is that which Electro Metallurgical Co. operated at Mead, Wash., near Spokane. Rated at 48 million pounds of magnesium annually, the plant was also equipped to manufacture ferrosilicon, which is at present being produced there by Pacific Northwest Alloys Co. It was understood in November that a contract for operation of the magnesium furnaces would probably be awarded to one or the other of these two companies.

Biochemistry Building Planned

In order to permit the present enrollment of biochemistry students to be doubled, the University of California is planning the erection of a $1.5 million biochemistry building and virus laboratory at Berkeley. It was expected last month that the necessary approval of the project by the board of regents would be secured and that construction would begin next spring.

Paper Firms Improving Plants

Pulp and paper manufacturers in the Pacific Northwest continue to be hard pressed to meet constantly rising demands for their products, and despite postwar expansions in capacity during the last several years are still investing millions in new equipment to increase capacity or improve products.

One such company, Powell River Co., having already let contracts totaling $2 million for construction at its plant at Powell River, B. C.; this year, is now planning to add more equipment and improve machinery to increase output. The new facilities include equipment to bring more power to the plant, an eighth steam boiler, a new turbo-generator rated at 10,000 kw., a third hydraulic barker, and two new lines of pulp grinders.

At Bellingham, Wash., Puget Sound Pulp & Timber Co. expects to complete by next April a $1.3 million expansion program designed to enable the plant to produce a full range of pulps including unbleached, semi-bleached, and bleached. The company is now earning about $25,-

000 per month, before taxes, on the operation of its equipment for production of industrial alcohol from sulphite liquor.

Crown Zellerbach Corp. has awarded a $400,000 contract for installation of new chip handling equipment at the mill at Camas, Wash., for the purpose of substantially increasing the capacity of the wood mill.

Cement Plant Being Enlarged

Calaveras Cement Co. is spending $600,000 to enlarge facilities at its cement plant at San Andreas, Calif. The project follows the completion less than a year ago of a $2.5 million postwar expansion which brought the capacity of the plant to 2.5 million bbl. of cement per year.

The company is now installing four additional slurry silos, additional raw and finish mills and four more cement storage silos. When the expansion is completed the plant will be able to continue production at capacity during the winter months in order to build up inventories.

Washington Researchers Organize

A new organization has been set up in Washington to publicize the private and public research facilities of the state available to the chemical processing and other industries. It is known as the Washington Council of Research Laboratories. Officers include Dr. T. L. Swenson, of Food Chemical and Research Laboratories, Seattle, as chairman; Tom Williams, Northwest Laboratories, Seattle, vice-chairman, and W. W. Philbrick, Experiment Station, University of Washington, secretary.

The membership committee is headed by Dr. H. K. Benson, Department of Chemistry and Chemical Engineering, University of Washington. A directory of members in the council and the objectives and facilities of the members is available. Among members included last month were: Bennetts Chemical Laboratory, Division of Industrial Services of the State College of Washington, Drumheller Analytical Laboratory, Engineering Experiment Station of the University of Washington, Food Chemical and Research Laboratories, Louis E. Jeklin, Lambert & Lent Laboratories, Laucks Laboratories, Northwest Laboratories, A. J. Norton, and Universal Laboratories.

New Potash Firm Sinking Shaft

Southwest Potash Co., subsidiary of American Metal Co., Ltd., has let a contract to Winston Brothers Construction Co., Minneapolis, to sink Southwest's first shaft in the Carlsbad, N. M., potash field. The parent company has access to funds up to $15 million to complete the new operation at Carlsbad and for other purposes. It is estimated that a total of about $10 million will be required, exclusive of working capital, for the Carlsbad undertaking. If materials and labor are obtained as needed, production is expected to begin in late 1952 with an initial annual capacity of 185,000 tons.

School Gets Engineering Station

An engineering field station with about 100 acres of land has been acquired by the Institute of Engineering Research in the University of California at Berkeley. The site of the new property, known as the Richmond Field Station, was formerly owned by California Cap Co. Prof. H. A. Schade, director of engineering research, will be in charge of the station.

The acquisition is the result of a long period of planning to meet expanding needs of the research program in the department of engineering at the university. Space is being reserved at the station for later construction of a forest products laboratory and other structures to house investigations on a laboratory and pilot plant scale.

NAMES IN THE WEST

L. M. K. Boelter

L. M. K. Boelter, dean of the college of engineering, University of California at Los Angeles, has been named a Fellow in the American Society of Mechanical Engineers. The honor is an award going to engineers who have made highly significant contributions to the advancement of engineering. The award to Boelter, was made on the basis of his research in heat and mass transfer as well as other fields.

Herman N. Simpson, vice president of Cellulose Engineers, Inc., before the recent dissolution of the firm, has opened an office in the Central Building at Seattle to engage in engineering consulting work.

Malcolm W. Clark, formerly with Atlas Steels, Ltd., Welland, Ontario, has been appointed to the metallurgical section, engineering division, British Columbia Research Council.

W. A. Newhoff, formerly a vice president of Union Oil Co. of California, has been elected executive vice president of Ranier Brewing Co., and will supervise sales.

Leland A. Doan has become manager of western sales at San Francisco for Dow Chemical Co. He succeeds **J. F. Smith,** who has assumed other duties. Doan is son of Leland I. Doan, company president.

Richard W. Dorst has been named West Coast secretary of the Liquefied Petroleum Gas Association, succeeding **K. B. Jacobsen.**

V. Seeberg

Victor P. Seeberg has become director of the new department of research in pharmacy and pharmacology for Cutter Laboratories, Berkeley, Calif. The department is an expansion of the pharmacy section of the company's chemical research department. Dr. Seeberg has been in charge of the pharmacy section, and has been with Cutter for seven years. He is a graduate of the University of Washington.

Harry Liss, president of West Coast Industries, Inc., is president of a new organi-

zation, Northern California Plastic Fabricators Association.

Paul D. Christerson, who was previously a sales engineer with Pope & Talbot, Inc. has become manager of the creosoting department of his company, with offices at Portland.

J. H. Kennesson, vice president and general manager of Gardiner Lumber Co., is scheduled to be in charge of a new plywood plant to be built at Gardiner, Ore., completion being set for late 1951.

Basil Kantzer is manager of a new section in Union Oil Co. of California known as the natural gas and gasoline department. He superintends all matters relating to natural gas and its products. He was formerly manager of field operations for the company's Pacific Coast division. He joined Union Oil in 1934 after graduation from Stanford University, and has occupied several posts in the company's production operations prior to his new appointment.

Charles D. Thurmond, formerly in Monsanto Chemical Co.'s San Francisco office, has been appointed assistant director of development for the company's Western Division, with headquarters at Seattle.

H. W. Hargrave is manager of the newly established intermountain district of Pabco Products, Inc. Office of the new district is at 428 South Main St., Salt Lake City. Although Pabco previously had a Salt Lake City office, the new district has been set up because of increasing demands for protective coatings and building materials in the mountain region.

G. B. Shea, acting supervising engineer of the petroleum and natural gasoline branch of the U. S. Bureau of Mines in San Francisco, has been named chief of the fuels technology division. **Harold C. Miller** succeeds him.

C. F. Hansen

Clarence F. Hansen is newly elected vice president of California Research & Development Corp., and will supervise construction work in connection with the investigations which the company, an affiliate of Standard Oil Co. of California, is carrying out at Livermore, Calif., for the Atomic Energy Commission. Hansen has been president of Calmara Oil Co., another Standard affiliate. **A. W. Gleason,** who joined Standard in 1917, has become manager of operations at Livermore. Gleason was formerly superintendent of process analysis and development at Standard's refinery at Richmond, Calif.

W. L. Spencer has become manager of refinery sales for Union Oil Co. of California and is in charge of the company's marketing outside of its domestic territory, exclusive of foreign sales. **Dean P. Hunter** has been named manager of sales for the Sacramento district.

OBITUARY

E. H. Zeitfuchs, 60, an authority on the properties of petroleum, died last month at Berkeley, Calif. He retired in 1946 as senior physical specialist for Standard Oil Co. of California. His inventions inculded the Zeitfuchs viscometer and other equipment for measuring flow characteristics of petroleum.

FIRMS IN THE WEST

West Tacoma Newsprint Co. has assumed direct management of its plant at Tacoma following dissolution of the former operating firm, Cellulose Engineers, Inc. N .F. Robertson remains as manager of the plant. Charles J. Brown has become superintendent, succeeding J. W. Edwards, retired.

Laucks Laboratories, Seattle, has named the following new officers: F. P. Owens, president; G. O. Freeman, vice president; J. E. Hefferline, secretary; B. B. White, treasurer; and I. F. Laucks, John T. Laucks, Helen V. Laucks, Owens and Freeman, directors.

Lever Brothers Co. expects to put into initial operation at Los Angeles its new $25 million soap and edible products plant early in February. Construction is past the half way point. The first portions of the

plant to be completed are those for the production of detergents. Soaps and edibles will come later. Charles T. Atwood will be plant manager.

Pennsylvania Salt Manufacturing Co. has opened a new sales office at Berkeley, Calif. R. A. Snyder is in charge of technical sales for metals and maintenance cleaners and J. C. Siddall handles sales and service for agriculture.

Coos Bay Pulp Corp. is spending $80,000 for construction and replacements in its plant at Anacortes, Wash. The work is scheduled for completion in January.

Tamco Laboratories is a new firm opened at Compton, Calif., to manufacture protective coatings, flame retardants and rust removers. The company was formed by Charles Talmadge, who formerly manufactured similar products at Mexico City.

Byrd-Frost Corp., Dallas, is drilling a 6,000-ft. test well near Monticello, Utah, to ascertain the presence of natural gas. The company also plans to drill another exploratory well in the vicinity of Salt Lake City, and a third well in Emery county.

Rezolin, Inc., Los Angeles, has become national sales agent for "8000" Tool-Plastic, a liquid phenolic casting resin manufactured by Durez Plastics & Chemicals, North Tonawanda, N. Y.

Swift Canadian Co., Ltd., has opened a new adhesives manufacturing plant at New Westminster, B. C. Products include dextrin pastes, resin and rubber-based emulsions and specialized adhesives. This is the company's fourth plant in Canada, and is managed by C. W. Hamilton.

Cement Corp. of America is a new organization contemplating the construction of a cement plant that would be built near Ojai, Calif.

Potlatch Forests, Inc., expects to complete early next year its new sulphate pulp and paper mill at Lewiston, Ida. Between 150 and 200 tons of paper per day will be manufactured.

Sick's Spokane Brewery, Spokane, Wash., is planning to increase its present production of 175,000 bbl. per year to 250,000. Work will begin this month on the construction of new cellars, a new refrigeration system and subsidiary equipment.

Memo from the Editor

Who's Going Where

A few weeks ago, when I was thumbing through the proof pages for this issue's "Names in the News" (p. 116) I ran across one name that brought back a flood of memories.

It was that of Robert Killingsworth, a classmate of mine at the University of South Carolina back in the early years of the "depression decade." For 17 years I had not seen Bob nor had known what had happened to him; naturally I was glad to learn that he's now assistant director of Socony-Vacuum's technical service department in New York.

Bob's name brought back mental pictures of a toxicology laboratory and our troubles in finding out whether it was strychnine or something else that had killed that old dog; of Dr. Copenhaver's delightful way of inserting sly humor into every organic experiment; of the late Dr. Mills' out-of-this-world enthusiasm when he lectured on atomic structure; of Bob's help to me with those loathsome problems on reaction kinetics.

"I wonder," I thought to myself, "what other memories this month's 'Names in the News' would bring up?" So I slowly went through the whole list, name by name.

I found 21 names that sparked pleasant memories: a visit to a plant on the Houston Canal, an evening talking about the geological glories of Utah, a frightening plane ride back from Pittsburgh, an AIChE symposium on liquid-liquid extraction, a tough manuscript that turned a critic into a friend, a plant interview with a reader in Detroit, climbing to the top of a cat cracker during an Illinois snowstorm, a free lunch in Dow's cafeteria at Midland, an article that took four long years to get, the visit to Hanford on VJ-Day (and being kissed by a young woman, crying from sheer happiness, in front of the Officers' Club).

It was then that I realized, for the first time, the deep and real pleasure that can come from following friends and acquaintances as they shift and rise in this small world of chemical engineers.

Bits and Pieces

• This month's pictured flowsheet—the 144th in our monthly series—shows how American Cyanamid makes aluminum sulphate or "filter alum" (p. 172). American chemical plants turn out close to 600,000 tons a year of this venerable but basic product, yet precious little has ever been published on how it's actually made in a modern plant.

• For those of you who found our November Materials of Construction report useful, here's good news. We will continue it, beginning in February, in our regular Corrosion Forum department. During 1951 we will cover in detail at least six more chemicals versus 15 or more construction materials.

• Coming: A report on solvent extraction processes in the fast-moving vegetable oil industry. It will tell about recent advances, new continuous methods, equipment, how products and byproducts are separated and purified.

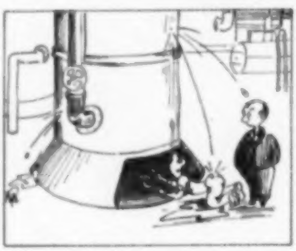
• Several months ago I mentioned our research work on finding out exactly what you read and what you like in *Chemical Engineering* (so we could give you more of both). Next month I'll tell you something about the results of one special survey that has just been completed. We're told it is the most comprehensive readership analysis ever made on any chemical publication.

• More than one secretary has addressed letters to us as *Chemical & Medical Engineering*. But last month's world confusion really got one poor thing into sending a letter to *Matchergick Engineering*. And from the credit department of Dun & Bradstreet, too!

• Recent advice on how to be an outstanding failure: "Keep your nose to the grindstone; don't expose yourself to new ideas by getting out and mixing with other men in your own or other plants. Better wear out your nose than your brains."

• "To succeed an engineer must learn how to get along with the man above, the man alongside, the man below and with his own self."—Philip W. Swain.

LITTLE BONERS



With a Grain of Salt

The manager of operations was a pusher—famous for getting results quick and saving money fast. He had precious little patience with research; that was only something for old fogies to piddle and putter in. He was a man of action.

One day someone suggested that a certain new raw material might be worth investigating for use in one of the company's operations. Sure it was suitable and wouldn't it be cheaper? Lord, and how!

A few beaker tests gave results that were wonderful. "Let's get going," urged Mr. Manager. The chemists got going, but they weren't fast enough. So the engineers were told to design a plant. They did, and built it. Those researchers were so slow.

The plant was put into operation. Nothing went wrong. The company cut the price of the chemical, practically cornered the market. The president got a glowing report on the profits that were piling in.

But after a while a trace of iron began to show up in the product. Finally the plant was closed down, the absorption tower inspected. It was perforated. The researchers had been so pushed that they never got around to making a trace element analysis of that wonderful raw material: less than 0.05 percent of salt in it finally liberated enough chlorine in the closed system to chew the tower lining to pieces.

About $150,000 worth of special equipment was scrapped—all because of too much haste and a bit of salt.

Mr. Manager happens to be still with the same company—but not in the same job. Watch for other "Little Boners" to come.

DECEMBER
1950

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

PROCESSES AND PRODUCTS

ENGINEERING AND EQUIPMENT

NEWS AND TRENDS

PEOPLE AND FIRMS

LITERATURE AIDS

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OPERATES WITH EASE
Cylindrical Plug Valve
Quick turning is an outstanding advantage of a.c.f. design. No wedging in its seat. The precision-machined Cylindrical Plug, pressure lubricated on all seating surfaces is always free to turn. It could be critically important in your plant. Reason enough to give a.c.f. Lubricated Plug Valves preference.
CYLINDRICAL
FULL PIPE AREA
LUBRICATED
a.c.f. PLUG VALVES
Representatives in more than 50 Principal Cities.
Ask for 4-OG American Car and Foundry Company, Valve Division, 1501 Ferry Ave., East, Detroit, Mich.

Available in sizes ¼" to 2". Each size with expanded outlet if desired.

Why the CASH STANDARD TYPE 1000 *Streamlined* PRESSURE REDUCING VALVE

....DOESN'T BECOME GUMMED UP FROM DIRT-SCALE AND VISCOUS MATTER..

● There are no complicated inside works in the "1000" valve. As a matter of fact there is only the one vital moving part — the seat piston. There are no restricted passages, no small ports, no aggregation of close fits. It's streamlined all of the way.

The seat piston is opened in a positive manner by the force of the initial pressure and is closed in an equally positive manner by the force exerted by the delivery pressure on the diaphragm. The seat piston is tied to the diaphragm by the rocker arm so that when the diaphragm moves it must move too.

Thus, the positive moving valve arrangement in STREAMLINED housing, with its continuous-duty performance insures against trouble from gumming up, thereby minimizing maintenance.

PERFORMANCE RESULTS FROM *Streamlined Flow*

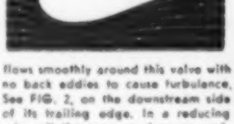
1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

Write for Bulletin "1000" which gives details on the performance of this "Streamlined" 1000 valve and its benefits.

How Streamline Design Works

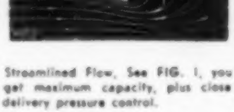
● Flow has been streamlined for straight flow into the delivery passage and jet. See FIG. 1. The fluid

FIG.-1



flows smoothly around this valve with no back eddies to cause turbulence. See FIG. 2, on the downstream side of its trailing edge. In a reducing valve all the pressure drop or work of pressure reduction should occur at one place, namely where the valve throttles flow, and not on the downstream side of the valve. Where you have downstream turbulence, See FIG. 2, the greatest amount of turbulence with resultant greatest pressure drop will occur when you want maximum flow and therefore want least pressure drop—if the delivery pressure is to be maintained. With

FIG.-2

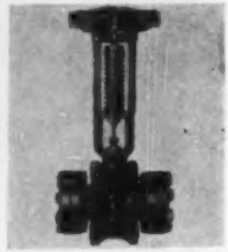


Streamlined Flow, See FIG. 1, you get maximum capacity, plus close delivery pressure control.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 33 Relief Valve; in various metals to handle nearly all fluids. Has Roller guides on valve spindle; also roller bearing to take care of spring torsion. Sizes ½" to 3" screwed ends; 1" to 12" flanged ends. Bulletin 971.

Cash Standard Type Q Relief Valve has side inlet, bottom outlet. Popular for pump bypass use. Sizes ½" to 2" screwed ends. Relief pressures up to 350 lbs., temperatures up to 500°F. Bulletin 943.

Cash Standard Type 4190 Valve for relief (bypass) use; holds constant valve inlet pressure regardless of changes in load or outlet pressure. Multiport—large capacity. Iron or bronze bodies; iron or bronze trim. Sizes ½" to 2" screwed ends; 2" to 6" flanged ends. Bulletin 952.

☆

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BIRD's Your Best Bet

Whatever your solids-liquids separating jobs, BIRD is your likeliest source of unbiased, prompt and dependable assistance in getting them done the one best way.

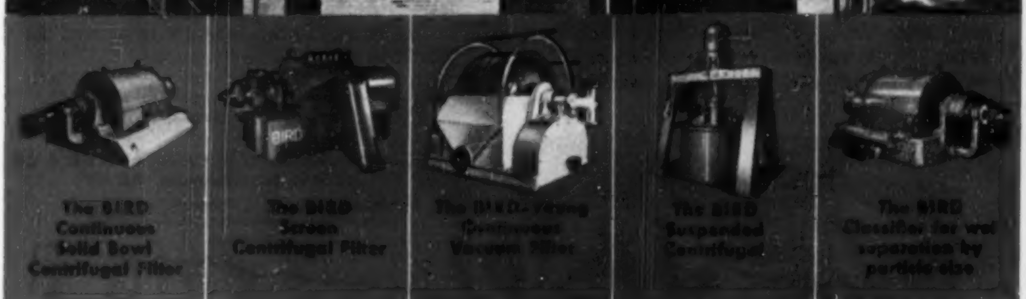
Unbiased because BIRD makes a broad range of equipment for solids-liquids separations.

Prompt and Dependable because the Bird Research and Development Center has complete and up-to-the-minute facilities for development of authentic, pilot scale, test findings.

Pooled here is the knowledge, experience and means to come up with the right answers on your solids-liquids separation problems. Now is the time to bring them to BIRD.

BIRD MACHINE COMPANY
South Walpole, Mass.

The Bird Research and Development Center



The BIRD Continuous Solid Bowl Centrifugal Filter

The BIRD Screen Centrifugal Filter

The BIRD-Young Continuous Vacuum Filter

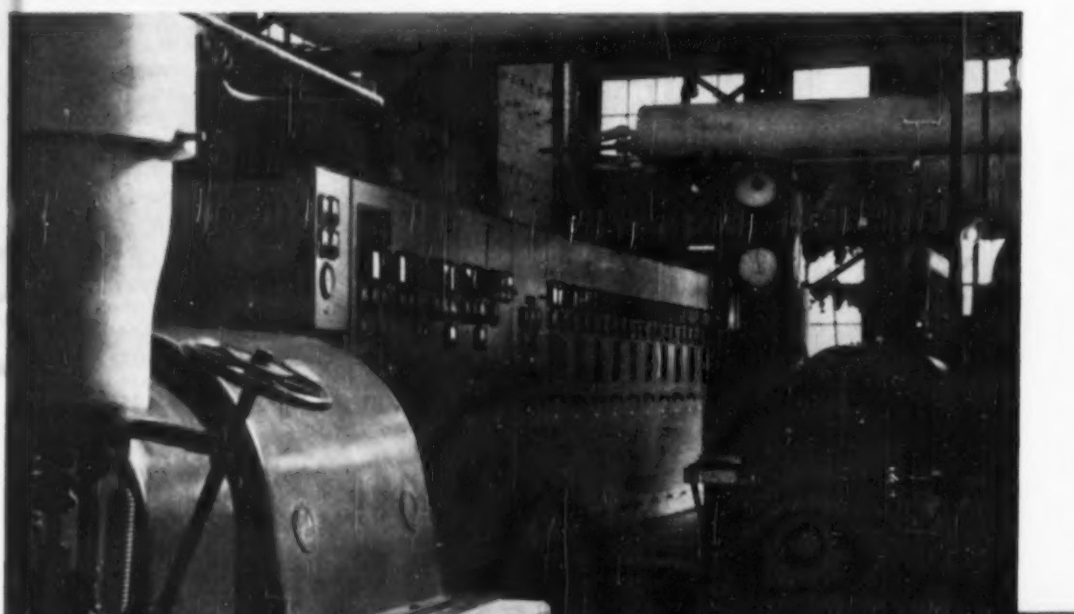
The BIRD Suspended Centrifugal

The BIRD Classifier for wet separation by particle size

FREEPORT SULPHUR EXPANDS

This inadequate, open-type switchgear was replaced by the new G-E Metal-clad equipment shown below. Freeport Sulphur officials recognized that the old switchgear had outgrown its usefulness.

Here's the new General Electric 5-kv Metal-clad switchgear installed at Freeport Sulphur. Magne-blast power circuit breakers have plenty of "IC" (Interrupting Capacity) to handle all short circuits that may occur on Freeport's expanded distribution system. This assures continuous power for vital production.



meet the "Sandman"

Yep! . . . there really is a sandman! Sivyer's sandman, however, is a symbol of vigilance . . . for he uses special equipment and a broad practical knowledge to test sand for specific moulding jobs. Dimensional accuracy, the finish, even the internal flawlessness of a casting may depend on his tests for proper bond, grain size, and permeability. The unique skill of our sand laboratories is another Sivyer service that insures casting quality and integrity for you.

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Life ...on the

FRUIT GROWERS report excellent results in the control of pear psylla with THIOPHOS® Parathion. In the test shown, damage by psylla caused the defoliation of the Anjou pear tree, while the other tree on the left was protected against this pest by parathion. Fruit and vegetable yields generally are up where crops are protected by this insecticide against mites, aphids, red spider and many other insect pests.

NEW PRODUCT NEWS

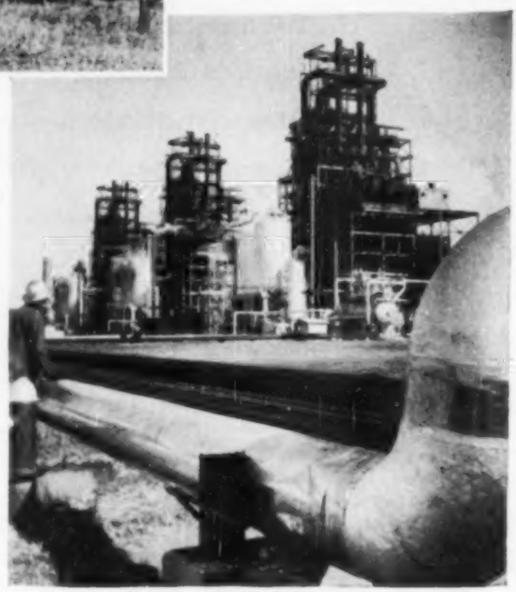
$O(CH_2CH_2CN)_2$ β,β'-OXYDIPROPIONITRILE

$S(CH_2CH_2CN)_2$ β,β'-THIODIPROPIONITRILE

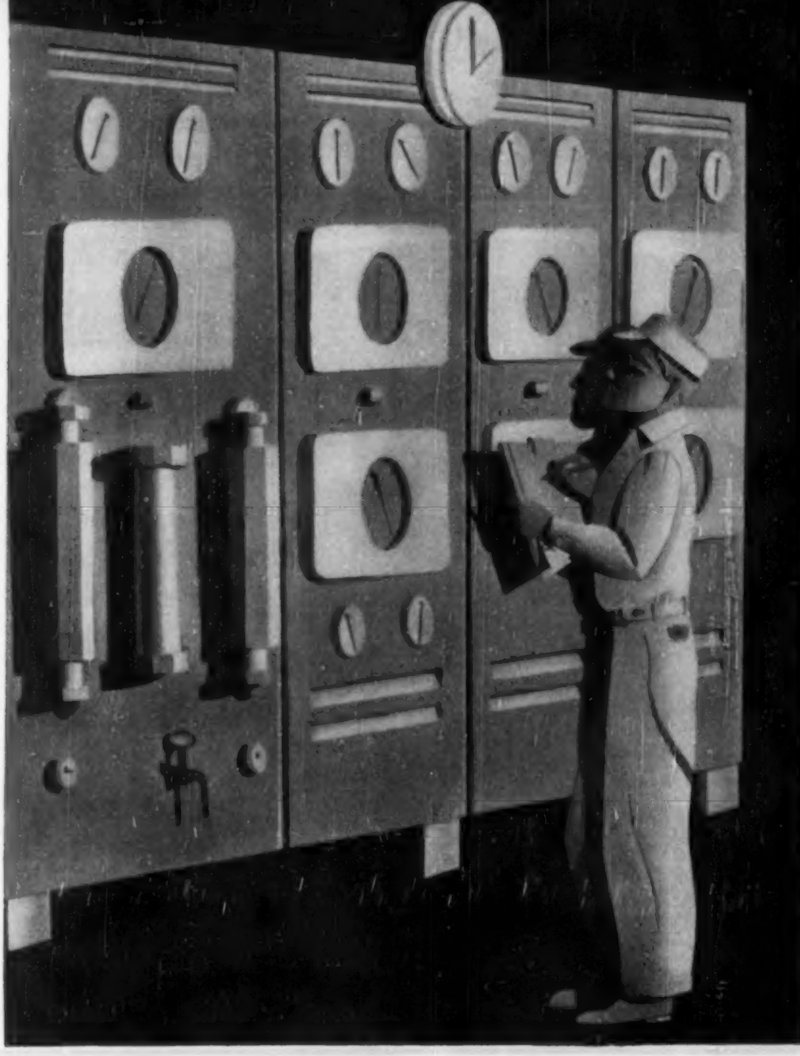
$NH(CH_2CH_2CN)_2$ β,β'-IMINODIPROPIONITRILE

Can the Dipropionitriles Help You?

The selective solvent action of the dipropionitriles makes possible the separation of mixtures of compounds that are difficult or impossible to separate by the usual methods. Other applications include the possible use of dipropionitriles in the purification of hydrocarbons and in refining tall oil, vegetable oil and wood rosins. To receive technical literature, check the coupon.



CYANAMID BUILDS in Michigan City, Indiana, to meet the increased demand of "cat" crackers for more fluid catalyst. This new plant will make available to the petroleum refining industry greatly increased quantities of AEROCAT® Microspheroidal Synthetic Fluid Catalyst. When completed the plant will supply the East, Middle-West and Canada, supplementing Cyanamid's Ft. Worth plant serving the West and Southwest.



ANOTHER REASON
WHY YOU SAVE MONEY USING "BUFFALO" DS* PUMPS

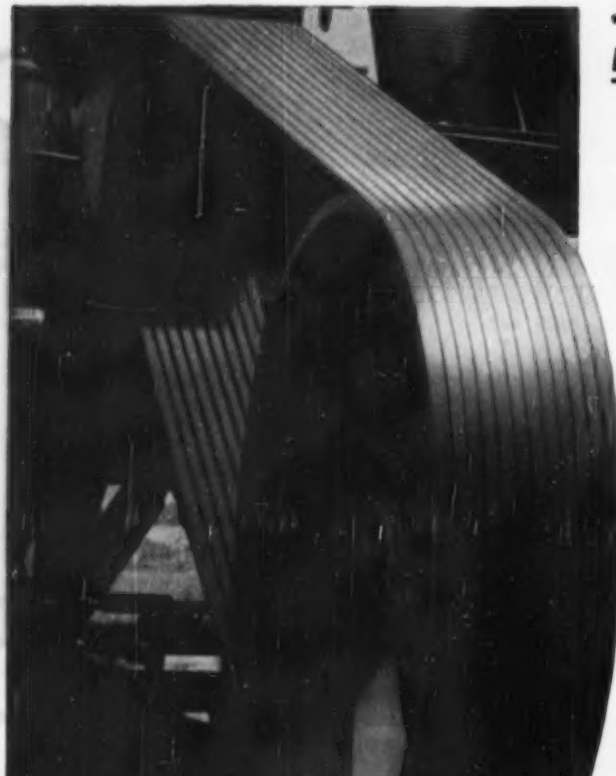
Bearing Cover Also Readily Removable
Above, showing "Buffalo" Rubber-Lined "DS" Pump with bearing cover removed. Note rugged construction throughout.

"Buffalo" Diagonally Split-Shell* Pumps save many production hours and maintenance hours through this convenient feature. Upper half of pump casing can be removed without disturbing discharge piping, just by removing a few bolts. This is ideal for handling liquids containing semi-solids as in the rayon industry. Users also appreciate the rugged construction—the lasting efficiency—the non-clogging design of "Buffalo" DS Pumps.

WHY NOT WRITE FOR YOUR FREE COPY of Bulletin 982 for all the facts on this and other proven "Buffalo" Pumps for every chemical liquid?

BUFFALO PUMPS, INC.
501 BROADWAY BUFFALO, NEW YORK
Canada Pumps Ltd., Kitchener, Ont.

WE CALL THEM "BULL DOGS" —you'll call them "WORKHORSES"



. . . these Tough Longer-Lasting V-Belts

TODAY with production at peak levels it pays to put your money on the right horse—a V-Belt that's a real "workhorse"! Dependable Bull Dog V-Belts have the built-in stamina that assures longer, no downtime operation that keeps production up and maintenance costs down.

And here are 4 reasons why Bull Dog V-Belts give you more for your belt money in trouble-free service, less slippage and savings through longer life:

1. Specially Engineered BWH Cord Section has high tensile strength. Result: superior load carrying capacity and ability to absorb shock loads.

2. Minimum Stretch — due to a new and exclusive technique in processing Bull Dog Cords. Result: less slippage, fewer adjustments, extended life of the belt.

3. Durable Covers — closely woven, heavy, bias-cut fabric takes the severe wearing action where the belt contacts the sheave and seals the belt against the penetration of dirt, grease, moisture.

4. Takes Punishing Flexing — BWH technologists with a 72-year background of leadership in mechanical rubber products have developed quality-controlled compounds which run cooler and do not crack or deteriorate under severe flexing.

If you're using Bull Dog V-Belts now—more power to you. If not, it will pay you to switch—ask your BWH distributor.

TOUGH PROBLEMS INVITED — Don't hesitate to ask us or your nearest BWH distributor about your power transmission belting, conveyor belting and hose problems. We're specialists in making mechanical rubber products work *better, longer.*

BWH

DEPENDABLE RUGGEDNESS

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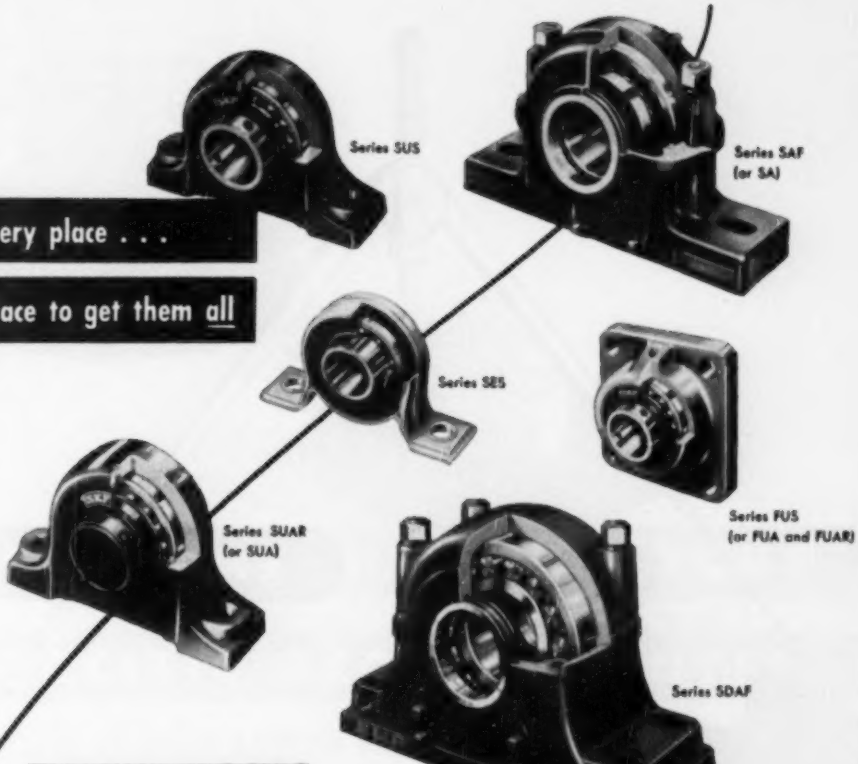
One for every place . . .

and one place to get them all

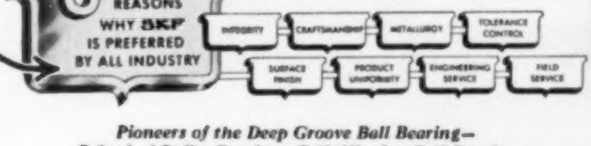


PILLOW BLOCKS ENGINEERED BY SKF

Specify pillow blocks and flanged mountings by SKF and you get bearings and housings engineered as a unit. What does this mean to you? It means you get the full benefit of SKF's skill and precision methods of manufacture. It means you're sure of minimum friction and trouble-free, low-cost operation. It means efficient seals that retain lubricant . . . keep out dust and abrasive elements. It means minimum maintenance . . . maximum efficiency.

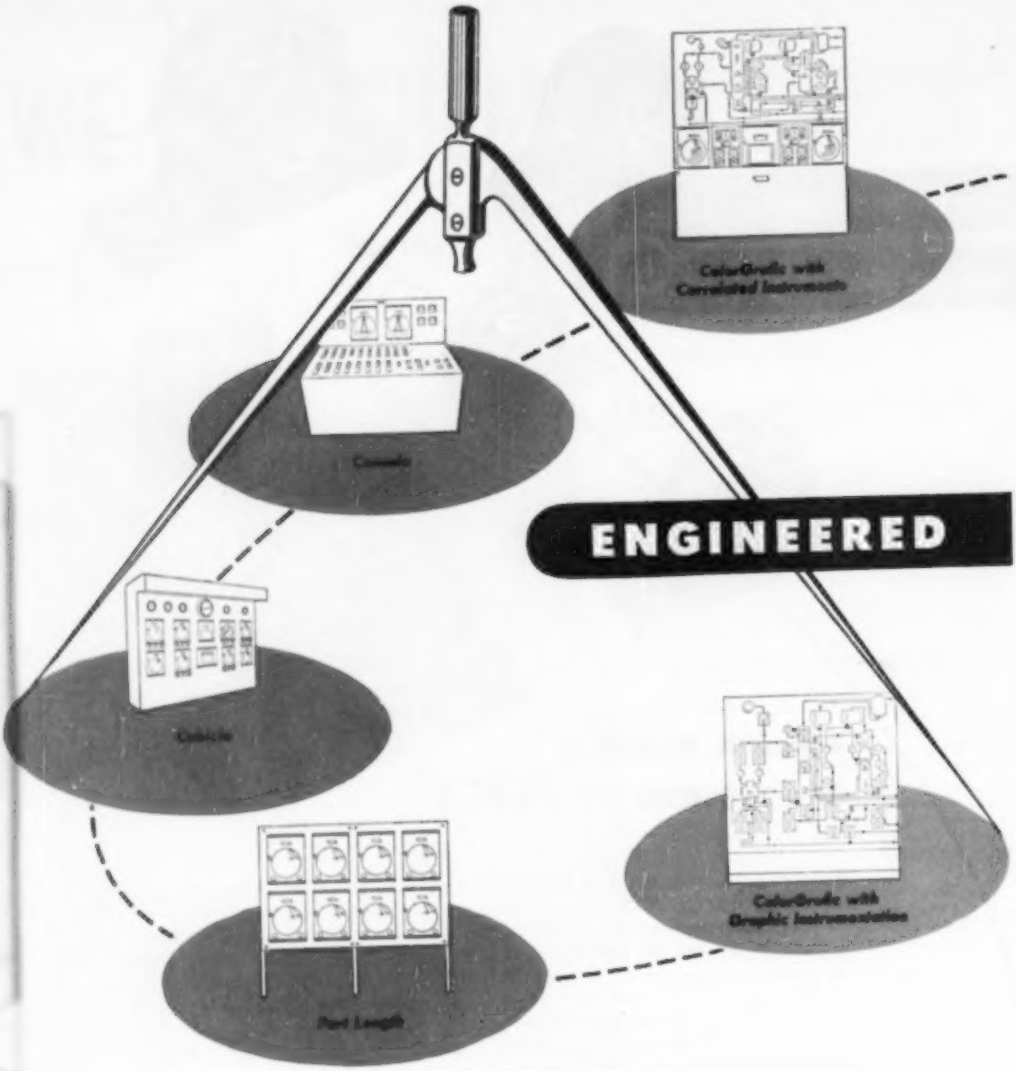
SKF supplies 5 basic types of pillow blocks for shafts from ½-inch to over 9-inches . . . and 2 basic types of flanged mountings for shafts from ½-inch to 2⁷⁄₁₆-inches. Whether you need Series SES for lightly loaded applications or Series SDAF to withstand unusual shock and heavy thrust loads . . . or any intermediate type . . . there's an SKF pillow block that's exactly right for the job.

Check your SKF Distributor, he has a stock of these pillow blocks and flanged mountings to meet *all* your requirements. SKF *Industries, Inc., Philadelphia 32, Pa.* 7044

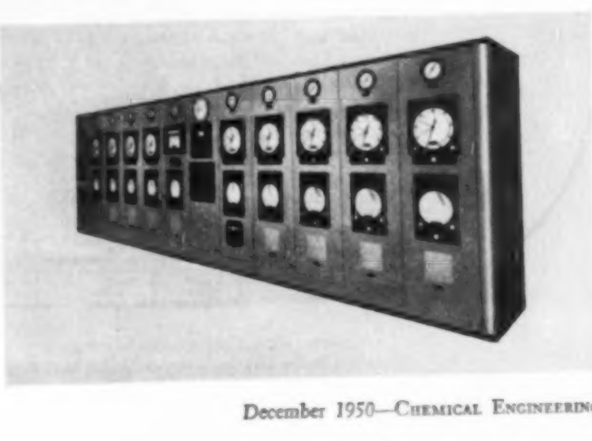


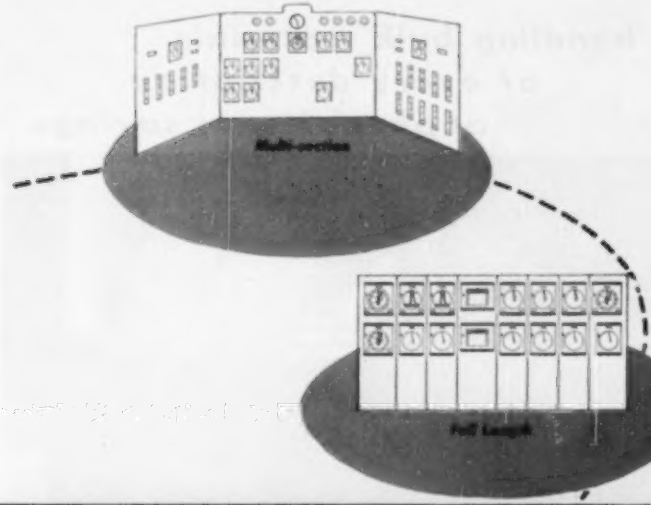
SKF
PILLOW BLOCKS

Pioneers of the Deep Groove Ball Bearing—
Spherical Roller Bearing—Self-Aligning Ball Bearing



This unit illustrates one of the variety of types of Packaged Panels now available to industry . . . engineered and assembled by a corps of panel design specialists to fit the specifications of the simple as well as the complex processes.





AND PACKAGED TO SUIT YOUR SPECIFIC REQUIREMENTS!

A BROWN *PRE-WIRED AND PRE-PIPED INSTRUMENT PANEL* AFFORDS THESE OUTSTANDING ADVANTAGES . . .

A Relieves you of costly details involved in obtaining panel materials, accessories and fittings . . . and preparing wiring and piping diagrams and layouts.

B Simplifies installation . . . you receive a complete unit, fitted to your process, requiring only a minimum of connections.

C Simplifies maintenance . . . orderly arrangement of instruments and components permits easy access for checking and service.

D Adds new efficiency and convenience to process operation by planned grouping of instruments for finger-tip control and at-a-glance checking.

A PRE-WIRED and pre-piped instrument panel can be designed and produced to your specifications in any one of the seven basic types illustrated!

Your local Honeywell engineer is qualified to discuss the details of your process requirements and to recommend the type of Packaged Panel best suited to your operations. Call him in today . . . he is as near as your phone!

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

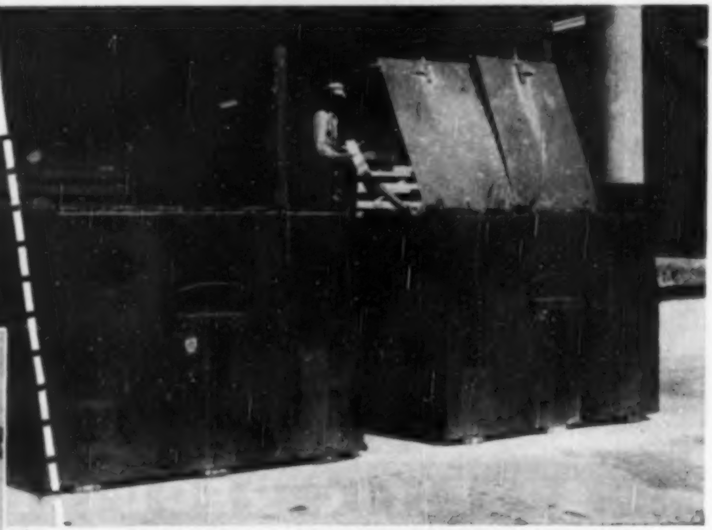
★

DEMPSTER DUMPSTER

SYSTEM

SERVING
COST-MINDED
MANAGEMENT
FROM COAST TO COAST

. . . handling bulk materials of every description at phenomenal savings



★ *—recognized across the nation*

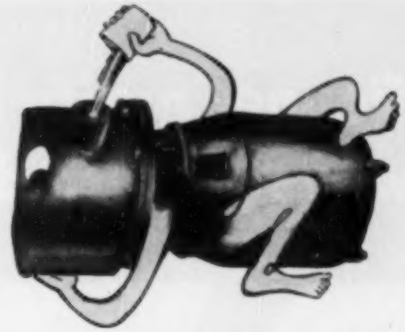
. . . Colgate-Palmolive-Peet Company, well known for sound management, uses the Dempster-Dumpster System.

Colgate-Palmolive-Peet Company is among the hundreds of well managed manufacturers, both large and small, who use the Dempster-Dumpster System of bulk materials handling . . . the system recognized across the nation for its efficiency and ability to reduce costs.

You will cut cost of equipment and operation . . . you will eliminate standing idle time . . . you will eliminate re-handling of materials . . . and you will increase efficiency and good "housekeeping" by installing the Dempster-Dumpster System in your plant now! In this system, one truck-mounted Dempster-Dumpster services any required number of detachable containers—and each suited to the particular materials handled—be they bulky, light or heavy . . . solids, liquids or dust . . . trash or rubbish. Large photo above shows how containers are placed at convenient materials accumulation points and are preloaded, in this case, with waste materials. With only one man, the driver, the truck-mounted Dempster-Dumpster picks-up, hauls and dumps one pre-loaded container after another, as illustrated in three photos at left. It will pay you to investigate the Dempster-Dumpster System now! A product of Dempster Brothers, Inc.

DEMPSTER BROTHERS, 2120 DEMPSTER BUILDING, KNOXVILLE 17, TENNESSEE

IN SELF-PRIMING PUMPS



ONLY THE NEW GOULDS GIVES ALL 5 IMPORTANT ADVANTAGES

1. **Absolutely no valves of any kind in pump**—nor are any needed in installation. Liquid can drain out of discharge and suction line through pump without affecting priming ability.

2. **No recirculation of liquid** after completion of priming action.

3. **Efficiencies** comparable to quality straight centrifugal pumps are thus obtained.

4. **Positive fast-acting self-priming** similar to priming ability of positive displacement pumps.

5. **No large or bulky priming chambers** or reservoirs, providing a compact unit at low cost.

PATENTS PENDING

YOU GET THE RIGHT PUMP FOR YOUR JOB FROM THIS COMPLETE LINE

PORTABLE

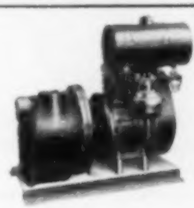
Compact, lightweight, with gasoline engine. Capacities to 58 G.P.M. Heads to 25 ft. Ask for Bulletin 639.1.

INDUSTRIAL

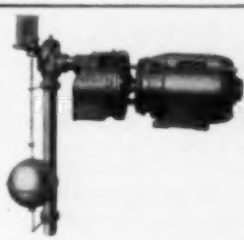
¼ to 5 H.P. ratings, open and closed impellers. Capacities to 120 G.P.M. Heads to 135 ft., suction lifts to 25 ft. Flexible coupling, or close-cupld motor drive. Ask for Bulletin 636.1.

GASOLINE ENGINE DRIVEN

1½ to 5 H.P., open and closed impellers. Capacities and heads same as Industrial. Available in close-cupld only. Ask for Bulletin 638.1.



SUMP



¼ to 5 H.P., capacities to 120 G.P.M. Heads to 135 ft. Equipped with float switch and elbow strainer. Pump is not submerged in pit. Ask for Bulletin 627.

MEMBER

For complete information see your nearest District Office, or mail the coupon.

Goulds PUMPS INC.
Seneca Falls
New York

GOULDS PUMPS, INC., Seneca Falls, N. Y.

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☐ Portable ☐ Industrial ☐ Sump Service
☐ Gasoline Engine Driven ☐ Complete Self-Priming Line

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Company________________

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Dr. Pepper purity is always protected

– in drums of Stainless Steel

– equipped with TRI-SURE CLOSURES

Dr. Pepper syrup is shipped to 440 bottlers in all sections of the United States. And to *protect* the purity of every gallon, the Dr. Pepper Company uses only *stainless steel* drums—equipped with *Tri-Sure Stainless Steel Closures**.

Just as stainless steel provides drums that are easier to clean, sterilize and handle, Tri-Sure Closures *keep* the contents secure from leakage, tampering and contamination.

Like other shippers to whom *product purity* is paramount, the Dr. Pepper Company standardizes on Tri-Sure Closures because the *flange* is integral with the drumstock . . . the *plug* screws securely into the flange . . . and the leak-proof *seal*, made of 195-lb. plate, prevents undetected tampering.

Give this protection to *your* product—eliminate risks in *your* shipments—by specifying "Tri-Sure Closures" when you order drums.

Tri-Sure
CLOSURES

*The "Tri-Sure" Trademark is a mark of reliability backed by 28 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Prepared Monthly by U. S. Industrial Chemicals, Inc.

U.S.I. CHEMICAL NEWS

December ★ A Monthly Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1950

Southern Agricultural Leaders See Practical Demonstration of New Control for Corn Insects

Guests Find 800 Bushels of Corn Still Insect Free After Treatment with Pyrenone Grain Protectant in June, 1949

THOMASVILLE, GA.—Pyrenone Grain Protectant, a new control for the insects which eat up half of the corn crop and thereby cheat the South out of a profitable livestock market, was recently demonstrated at the Greenwood Farms plantation to federal and state farm specialists and agricultural leaders from ten southern states. Dr. Walter E. Dove, director of entomological research for U. S. Industrial Chemicals, Inc., of Baltimore, and former chief of the Division of Insects Affecting Man and Animals, United States Department of Agriculture, said that the dream of the South in developing a livestock industry can never be realized as long as nothing is done to curb the insect menace.

150 agricultural leaders from Federal Government and 10 Southern states watching demonstration of application of Pyrenone Grain Protectant to corn.

"Insects, principally the rice weevil, eat almost as much corn and other grains as do animals in the South," Dr. Dove declared. "In too many instances, cattle have to be sold or otherwise disposed of in the spring because corn that was stored comparatively free of insect infestation in the fall is completely destroyed."

Dr. Dove spoke at a demonstration of the application of Pyrenone Grain Protectant on three types of corn storage, shelled, husked and unhusked. The Pyrenone Grain Protectant, which tests have shown to be free of toxicological hazards to humans and warm-blooded animals, is mixed directly with the corn to prevent insect infestation. Guests at the demonstration also inspected 800 bushels of corn which is still insect free after treatment with Pyrenone Grain Protectant in June, 1949.

Can Save Millions

Dr. Dove told his audience of 150 persons that the new insecticide can save the South untold millions of dollars. Its use, he said, is not limited only to corn, but can be effectively applied to rice, barley and other grains. A companion product, Pyrenone Wheat Protectant, was introduced this year for treatment of stored wheat. In both products the insecticidal ingredients are the same — a com-

MORE

New Chemical Assay for Panthenol, Pantothenates

Development of a rapid colorimetric method for the determination of panthenol and pantothenates has been announced. Since panthenol and pantothenates assume considerable importance as members of the vitamin B-complex family, the method should be of great interest to manufacturers of vitamin preparations.

The colorimetric procedure is based on formation of pantoyl lactone by hydrolytic cleavage in acid medium. The lactone reacts with hydroxylamine in the presence of alkali. The hydroxamic acid thus formed yields a purple color upon acidification in the presence of ferric chloride. This color is utilized for photometric measurements.

With the new assay, results can be obtained in shorter time than required by present microbiological procedure, it is claimed, with good agreement between both. The method reportedly can be applied for the assay of panthenol and d-calcium pantothenate in pure form as well as in tablets and ampuls. An adaptation of the method is said to deal with the determination of panthenol in multivitamin preparations. Through the use of an ion exchange resin column for the absorption and elimination of interfering ionic substances, the method is rendered specific for panthenol.

Booklet on Fundamentals Of Fire Extinguishment

A new 4-page booklet on fire has been released by a fire extinguisher manufacturer. It contains illustrated discussions of what fire is, classes of fires, and proper methods of extinguishment. Originally introduced as an aid in training company salesmen, it has been widely requested and used by fire departments, industrial fire brigades, insurance companies, and other fire protection groups. Copies are available from the company.

Patent Paper Parachute

A new, improved paper parachute is claimed to have many uses and to stand up under storage conditions. According to a recent patent, paper for the parachute is treated with 1 to 4½ parts of glycerine in 100 parts of commercial alcohol. When the paper has been thoroughly saturated, excess solution is removed and the alcohol is evaporated from the paper. Paper treated this way reportedly may be folded and tightly packed for storage without damage to it or cracking at the folds.

Dry Lubrication Processes

Processes said to impregnate surfaces of metals, plastics, rubber and ceramics with graphite so as to produce a dry lubricating film that reduces friction and wear are now being offered by an eastern firm. They are reportedly available on a job work basis, or if volume warrants, on a licensing arrangement.

New Data on Concentration vs. Germicidal Efficiency of Ethyl Alcohol

From the wide range of concentrations in which ethyl alcohol destroys the moist vegetative forms of bacteria, it appears that too much emphasis has been placed on the importance of diluting 95 per cent alcohol to a lower concentration. The statement that 95 per cent alcohol is practically worthless as a germicide needs to be qualified, according to a recent report in a scientific journal. It is not true when referring to the moist vegetative forms of bacteria.

Escherichia coli, *Salmonella typhosa*, and *Serratia marcescens* were killed, it is claimed, in 10 seconds or less by concentrations of ethyl alcohol of 100 to 40 per cent by volume. *Pseudomonas aeruginosa* was reportedly killed in 10 seconds or less by concentrations of 100 to 30 per cent by volume. Fifty to 90 seconds were said to be required to kill *Micrococcus pyogenes*, variety aureus, and *Streptococcus pyogenes*, respectively, by absolute ethyl alcohol. The organisms were killed in 10 seconds or less by concentrations of 95 to 60 per cent. Forty-eight hours were reported required to kill a 24-hour-old broth culture of *Bacillus anthracis* by concentrations of alcohol of 100 to 95 per cent.

Compounds in 50 per cent alcoholic solutions, which are recommended for disinfectants, probably owe their germicidal action in large part to the alcoholic solvent.

Mosquitoes Tagged with Radioactive Phosphorus

In an experiment in a western state, a million mosquito larvae have been treated with radioactive phosphorus. Within 24 hours, a larva absorbs enough P^{32} from a solution to make it detectable through its entire adult life. Later the mosquitoes are gathered and identified to determine two important facts: how long a mosquito lives and how far it flies. The work is expected to be the pilot study of future investigations of dangerous insects.

December ★ **U.S.I. CHEMICAL NEWS** ★ 1950

CONTINUED

New Control for Insects

bination of piperonyl butoxide and pyrethrins – and only the diluents, or carriers, differ. For Pyrenone Grain Protectant, fibrous talc is used as a carrier, and for the Wheat Protectant, finely-ground wheat is the diluent. The Pyrenone insecticides, he said, have been available commercially for several years, but their use in Grain and Wheat Protectants was investigated thoroughly for three years before they were produced for consumer use.

"The field tests with the Protectant have always shown a worthwhile degree of control

Some of party inspecting corn before and after treatment with Pyrenone Grain Protectant.

of the common grain insects, the degree of control depending upon the coverage obtained," Dr. Dove stated. Treatment of unshucked corn, which is always more or less field infested, can only give partial protection by preventing the spread of infestation to sound ears. Farmers say this is well worth while and they are not looking for miracles. On shucked corn, the degree of protection is much higher as the insecticide comes in direct contact with insects as soon as they emerge. The difference in the protection obtained certainly makes it worthwhile to shuck the corn before it is treated.

Dr. Dove said that a conservative estimate of protection on stored shelled corn was 10 months, and added that the treatment of stored shelled corn was definitely superior to that of the other two methods of storage now in common use.

Applying Pyrenone Grain Protectant by the layering method to snapped corn during the demonstration.

Develops New Vaccine Effective Against Mumps

Production of a preventive vaccine against mumps, one of the most common diseases of both childhood and adulthood, was announced recently. The vaccine, which may give immunity lasting for one year following the administration of two injections, is recommended for routine inoculation of children housed together in large groups, such as summer camps and orphanages, according to the announcement.

AIR NATIONAL GUARD PROTECTS AMERICA

The scientist who developed the vaccine stated that the virus used in its manufacture is cultured in chick embryos. After a suitable incubation period, the fluid from a sac called the allantois is removed from the egg and centrifuged to obtain the virus sediment. This sediment is put into solution, inactivated with formaldehyde, and standardized with respect to its immunizing capacity. Before the vaccine was released, the announcement stated, more than 1600 individuals received vaccine, the greater part of this number with the cooperation of a state board of health.

TECHNICAL DEVELOPMENTS

An emulsion-type synthetic resin wood glue, designed for high shear strength coupled with a minimum of cold flow, has been introduced. It can be prepared in any desired viscosity to suit needs of the fabricator. **(No. 629)**

A new clear, quick-drying, plastic synthetic finish for hardware made of brass, iron, copper, gold, cadmium, chromium, and nickel has been announced. It can be treated to give steel or aluminum a gold or brass appearance. **(No. 630)**

A chlorinated rubber-base enamel for application by spray or brush on tank exteriors, structural steel, and concrete subjected to severe chemicals, is said to stand up to chemical fumes, calcium chloride deposits, and other chemicals. **(No. 631)**

Denser, stronger, more uniform concrete blocks and bricks are said to result from addition to the mix of small amounts of a surface active agent. It permits use of less water, providing "dry" concrete of greater strength. At the same time, plasticity needed for molding blocks and bricks is improved. **(No. 632)**

A new portable electroplating set operating on 110 volts AC can be used in electroplating gold, silver, copper, nickel, brass, cadmium, and tin, it is reported. **(No. 633)**

A new water repellent said to make all types of fabric impervious to moisture will be introduced soon in "bomb"-type dispensers. **(No. 634)**

A new refillable ion exchange unit designed for small-quantity users delivers, from an ordinary faucet, water equal in chemical quality to triple-distilled. **(No. 635)**

An abrasive metal said to be corrosion resistant and unbreakable has been developed. High tensile strength and yield points, ability to withstand impact without cracking or breaking, and antislip qualities are mentioned by the maker as advantages in ladder and stair treads, car steps, and running boards. **(No. 636)**

A portable vapor steam generator which supplies large quantities of high pressure steam for short or sustained periods has been announced. This machine reportedly develops 200 lb. working steam pressure in two minutes from cold water and makes over 3,500 lb. of steam an hour, at 75- to 300-lb. steam pressure. **(No. 637)**

A packaged electrolytic plant for converting salt into caustic soda and chlorine at the point of use has been developed. It consists of a mercury cell complete with denuder, a power rectifier, brine operation tanks (arranged vertically), brine recirculation equipment and caustic receiving tank. Space occupied is 3.5 by 25 feet. **(No. 638)**

PRODUCTS OF U.S.I.

ALCOHOLS
- Amyl Alcohol (Isoamyl Alcohol)
- Butanol (Normal-Butyl Alcohol)
- Fusel Oil—Refined
- Propanol (Normal-Propyl Alcohol)

Ethanol (Ethyl Alcohol)
- Specially Denatured—all regular and anhydrous formulas
- Completely Denatured—all regular and anhydrous formulas
- Pure—190 proof U.S.P., Absolute—200 Proof
- Solox*—proprietary solvent—regular and anhydrous

ANTI-FREEZES
- Super Pyro* Anti-Freeze
- U.S.I. Permanent Anti-Freeze

ANSOLS
- Ansol* M
- Ansol* PR

ACETIC ESTERS
- Amyl Acetate—Commercial and High Test
- Butyl Acetate
- Ethyl Acetate—all grades
- Normal-Propyl Acetate

OXALIC ESTERS
- Dibutyl Oxalate
- Diethyl Oxalate

PHTHALIC ESTERS
- Diamyl Phthalate
- Dibutyl Phthalate
- Diethyl Phthalate

OTHER ESTERS
- Diatol*
- Diethyl Carbonate
- Ethyl Chloroformate

INTERMEDIATES
- Acetoacetanilide
- Acetoacet-ortho-chloroanilide
- Acetoacet-ortho-toluidide
- Acetoacet-para-chloroanilide
- Ethyl Acetoacetate
- Ethyl Benzoylacetate
- Ethyl Sodium Oxalacetate

ETHERS
- Ethyl Ether, U.S.P.
- Ethyl Ether, Absolute—A.C.S.

ACETONE — A.C.S.

FEED PRODUCTS
- Curbay B-G*
- DL-Methionine
- Riboflavin Concentrates
- Special Liquid Curbay*
- U.S.I. Animal Protein Factor Supplement
- Vacatone* 40

RESINS (Synthetic and Natural)
- Arochem*—modified types
- Arofene*—pure phenolics
- Aroflat—for special flat finishes
- Aroplaz*—alkyds and allied materials
- Congo Gums—raw, fused & esterified
- Ester Gums—all types
- Natural Resins—all standard grades

INSECTICIDE MATERIALS
- CPR Concentrates: Liquid & Dust
- Piperonyl Butoxide
- Piperonyl Cyclonene
- Pyrenone* Concentrates: Liquid & Dust
- Pyrethrum Products: Liquid & Dust
- Rotenone Products: Liquid & Dust

INSECTIFUGE MATERIALS
- Indalone*
- Triple-Mix Repellents

OTHER PRODUCTS
- Collodions
- Ethylene
- Nitrocellulose Solutions
- PIB*—Liquid Insulation
- Urethan, U.S.P.
- Special Chemicals and Solvents

*Reg. U.S. Pat. Off.

U.S. INDUSTRIAL CHEMICALS, INC.

60 EAST 42ND ST., NEW YORK 17, N. Y. U.S.I. BRANCHES IN ALL PRINCIPAL CITIES

America's Road to Victory

...Let's Increase Production

This is the time to speak out—now—at the beginning.

Our industrial program for re-armament is getting off on the wrong foot.

The talking and writing about it emphasize the wrong things.

Its headline words are "cuts" and "controls."

Those words make bad propaganda for the cold war.

"Cuts" and "controls" are no words to challenge the imagination and energy of our own people. They won't impress the masters of the Kremlin. And they can only make it appear to the rest of the world that America thinks it can defend the free way of life by abandoning it.

America stands as the world's champion against aggression because America has become the most powerful free nation in the world.

How did we get that way?

Not by putting ceilings on wages; not by rationing or clamping iron-clad government controls all over business and industry.

To be sure, some temporary controls are necessary to channel very scarce materials speedily to use for defense. So, too, are special taxes and credit restrictions needed to combat inflation. But they will be fatal if they blind us to this fact:

We became the strongest nation in the world by out-producing every other nation.

Production—The Final Answer

Next year our government is planning at least a $40 billion military program. Instead of planning only on controls to divert $40 billion of production from the making of civilian goods to the making of military supplies, we should be figuring out also ways to push up total production.

Of course, our industrial plant is running at close to "capacity" now. And our labor force has reached almost full employment. There isn't much slack to be taken up.

Can even the United States add a $40 billion miracle of production on top of what it is already doing?

Our answer is "Yes"—and within two years. It can be done by adding about $6 billion each year to our program of capital investment which now runs about $22 billion a year.

Part of this added production will come from expanding our industries. The steel companies, for example, already have plans to increase their capacity almost ten per cent in the next two years.

But by far the largest part of that $40 billion of added production must come from higher productivity—raising industry's efficiency.

continued on next page

To meet our goals we need to raise our productivity five per cent a year.

Can it be done?

The answer is an emphatic "Yes."

Raise Industry's Productivity

McGraw-Hill's studies of industry's equipment show that there are countless opportunities for improving efficiency. Our manufacturing industries alone need at least $35 billion of new equipment to raise their facilities to first class technical standards.

Here are some of the broad possibilities reported by the trained editors of McGraw-Hill's business magazines:

In many manufacturing plants as much as 40 per cent of workers' time goes into moving materials and parts—shifting things about within the plant between processes and to and from shipping platforms.

FACTORY estimates that improved materials handling equipment and methods might well cut handling costs twenty-five per cent and save annually over 650,000 man-years of unnecessary labor.

Modern machine tools designed since World War II are 40 per cent more productive, on the average, than is old equipment. But AMERICAN MACHINIST surveys show that 95 per cent of industry's machine tools are of designs at least ten years old. Replacing them could raise productivity of the metalworking industries at least ten per cent—enough to absorb a major share of the metalworking industries' part of the defense program as now planned.

In coal mining, latest equipment and methods can raise productivity sharply. The editors of COAL AGE estimate that production of bituminous coal could be raised from seven tons per man-shift to ten within three to five years.

Many new textile production techniques are 50 per cent to 75 per cent more efficient than those in use now. If plants could be fully modernized, and full use made of latest management methods, TEXTILE WORLD estimates that output-per-manhour would rise 20 per cent. *A FOOD INDUSTRIES study indicates that modern equipment plus the best management techniques could raise productivity in food processing at least 20 per cent.*

These are just some of the opportunities that industry can seize and by which the nation can profit.

A Nation-Wide Effort

Of course, industry itself can't do the whole job. Labor, government and all the rest of us must cooperate.

Government's part is to see that its emergency controls are so applied that they will increase productivity and thus make possible an early lifting of such controls.

Labor's part is to help in the development of labor-saving methods and machinery and to welcome their adoption as the only sure way of continuing to advance the American standard of living while maintaining the American free way of life.

For all of us the job is to work constantly for an expanding, ever-stronger America with constantly growing productivity; not a pinched and shackled America cooped up under wage and price ceilings and tied to a ration card.

Challenge to Industry

Here is a sharp challenge to industry to study the best work-methods that are being reported—to use every minute and every dollar it can to replace obsolete equipment.

Here is a sharp challenge to government to do everything within its power to make its control policies and its fiscal policies strengthen the incentives to industrial modernization—to demand sacrifice for a purpose and not for effect.

The job to which such opportunities point will take time—though nothing holds back adoption of some of the simpler improvements in work-methods reported in business magazines all the time.

But increasing production is our one best hope that we may be spared the full array of price, wage and production controls now and be freed eventually from all controls.

General Omar Bradley has said that the protection of our national independence calls for "long-range commitments that we are willing to carry out."

A long-range commitment to fight this battle for peace with America's most powerful weapon—industrial productivity—is the surest guarantee of victory for the free world.

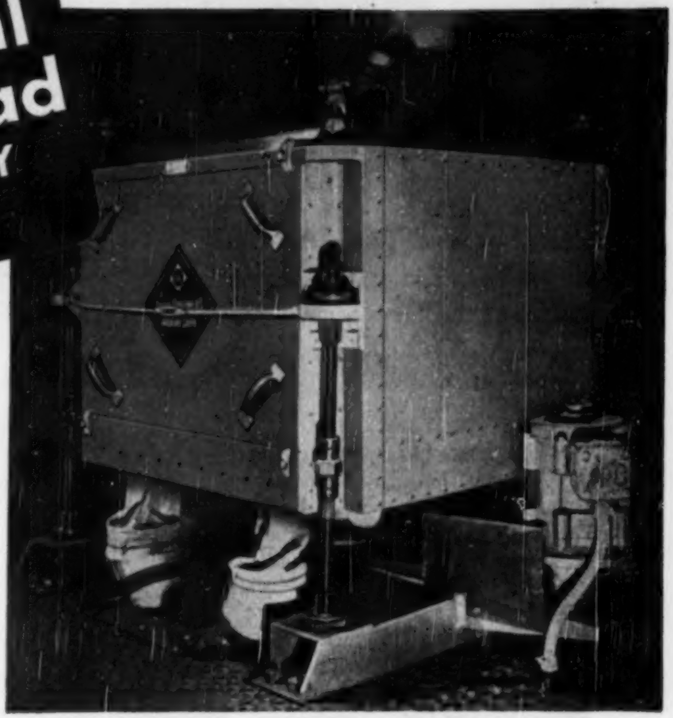
Let's make that commitment—now—at the beginning.

McGraw-Hill Publishing Co., Inc.

HERE'S ANOTHER EXAMPLE OF ALLIS-CHALMERS ALL-METAL SIFTER VERSATILITY—

Cork Grading!

All-Metal Low-Head GYRATORY SIFTER



★ WHERE INSTALLED
In a large Pennsylvania cork products company.

★ HOW USED
For grading and sifting of ground cork — used by tobacco companies to cork-tip ends of cigarettes.

★ CAPACITY OF MACHINE
This *Low-Head* gyratory sifter handles 200-250 lb per hour, 16 hours a day.

★ REPORT ON OPERATION
"Machine is very simple and above normal mechanically. Was installed six months ago and only maintenance so far has been routine greasing."

NEW A-C SIFTER HAS MANY CHEMICAL INDUSTRY APPLICATIONS

YES — THIS NEW all-metal *Low-Head* sifter is doing an excellent grading and sifting job for this cork products company . . . but that's only one of many applications for this versatile Allis-Chalmers machine.

It's ideally suited for *chemical processing* jobs because it is an *all-metal* unit. Made of steel and magnesium, the sifter handles high temperature materials safely. And it can be cleaned by *washing* with hot or cold water—without danger of warping. Sieve screens can be silk or metal, as preferred.

The *all-metal Low-Head* sifter is a high-speed, high-capacity unit holding four to seven sieves. It is similar in functional design to the *standard* A-C gyratory sifter used for years by food and chemical processors.

All-metal sifters are available *now* for prompt delivery. Get full details from our nearby Allis-Chalmers sales office or write direct.

A-3968

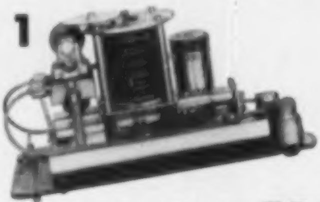
ALLIS-CHALMERS, 1147A SO. 70 ST.
MILWAUKEE, WIS.

Low-Head is an Allis-Chalmers trademark.

ALLIS-CHALMERS — **CHEMICAL MILLING AND PROCESSING EQUIPMENT**

TAYLOR TRANSET*

1

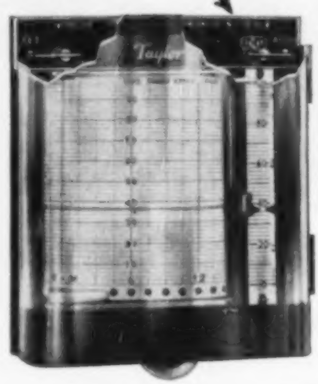


2

TRANSAIRE to TRI-ACT

to TRANSET

3

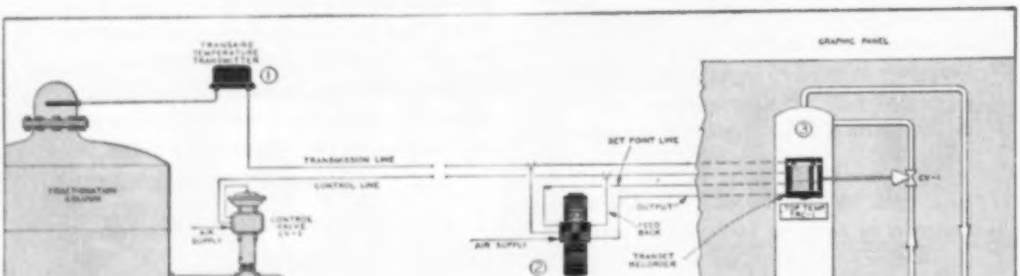


Tinker to Evers to Chance had nothing on Taylor's Transaire* to Tri-Act* to Transet*. They, too, form a well-coordinated combination. They combine 3 stars to make the fastest, most dependable pneumatic transmission system on the market.

1. TRANSAIRE. A force-balance temperature or pressure transmitter. Speed-Act* gives rate action in the measuring circuit to compensate for process lags. Narrow range spans. Standard 3 to 15 psi output. Interchangeable unit construction. Temperature and Barometric Pressure Compensations.

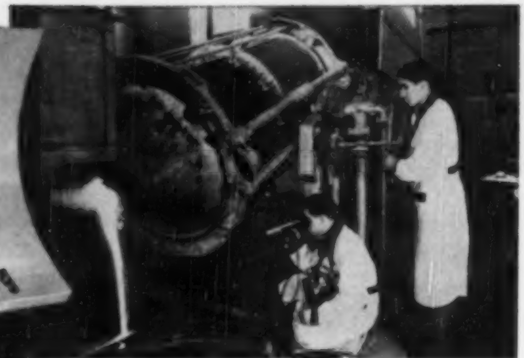
2. TRI-ACT Controller. A force-balance controller with a new circuit . . . a new concept in process control. High capacity relay air valve for faster response of control circuit. Wider response adjustments than ever before. Panel or locally mounted.

3. TRANSET Recorder. Fits $3\frac{7}{8}$" x $4\frac{1}{2}$" opening . . . a natural for graphic panels, a great space saver for conventional panels. Powerful actuation—bellows operated rectalinear movement. 30-day chart, 3-hour visible record. Everything needed for remote control.



CONTROL SYSTEM

GLASS-SURFACED STEEL TANK LININGS DEPEND ON GAS for perfect bonding



Poured from a Gas-fired rotary type smelter, frit batch is quenched at A. O. Smith plant.

With glass lining fused to steel, tank emerges from car-bottom type Gas-fired furnace.

Examination of interior best illustrates the contributions of controlled Gas-heat in fusing glass-to-steel.

GLASS AND STEEL FUSED WITH GAS HEAT form the mammoth sanitary storage tanks required by the brewing and beverage industries. Manufactured by A. O. Smith Corporation, Milwaukee, Wisconsin, these tanks, with capacities in the thousands of gallons, give graphic proof of the role GAS plays in industrial processes.

Steel sheets are welded into a single-piece tank and fittings installed. Sandblasted clean, the inside is sprayed with "slip" prepared from frit batches made in Gas-fired rotary type smelters. Dried by forced, filtered, Gas-heated air, the unit is ready to fire.

The furnace used for fusing, 56′ long, 17′ high and 15′ wide, is directly Gas-fired from 40 burners of about 1,000,000 Btu/hr input each. This furnace brings tanks well above the critical temperature of steel in the firing and fusing cycle. Inert gases pressure-forced into the tanks keep them from collapsing of their own weights, and maintain proper shape during quenching, as well as improving glass-surface quality.

Tanks are air-quenched. The precise temperature control afforded by GAS assures a flawless glass surface. Mirror smooth, the glass can bend within the elastic limits of the steel.

Why is Gas so useful in industrial applications like this? Because Gas is so readily adaptable to the demands of special processes like glass-to-steel fusion—because Gas permits rigid temperature control in critical operations. Your Gas Company Representative knows the facts. Call him today.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

MORE AND MORE...

THE TREND IS TO GAS

IT TAKES THE RIGHT VERSENE* TO DO THE JOB RIGHT . . . . .

The great and growing Versene family now has seven members. All of them are powerful organic complexing agents. All of them control cations in solution. All of them solve problems in metallic ion contamination . . . But only one (the *right* one) can do *your* job efficiently. This is why it's important for you to select the Versene best suited to solving your own particular problem.

VERSENES* ARE VERSATILE

So versatile are the Versenes that they can help you in almost any metallic ion contamination problem. They give exacting chemical control of troublesome cations by keeping them in soluble complex form. They are extremely efficient and amazingly stable at high temperatures and at all pH s. Investigate them now. Write Dept. B.

Send for samples and ask for Technical Bulletin No. 2. A clue to your problem will put a generation of experience in pioneering the polyamines at your command.

*Trade Mark

HOW TO CHOOSE THE RIGHT VERSENE*

VERSENE REGULAR
(the original Versene) is the sodium salt of ethylene-diamine-tetra-acetic acid. It is available in solution or dry form. It inactivates all metallic ions but is not a specific for complexing iron.

VERSENE Fe3 SPECIFIC
is the most powerful complexing agent known for iron in the normal pH range. It also chelates copper, nickel and cobalt.

VERSENE Fe3
is a combination of *Versene* and *Versene Fe3 Specific*. It complexes both iron and other metallic ions. The composition may be altered to meet individual requirements.

VERSENE T
complexes ferric and divalent metal ions *including* hard water salts in *concentrated caustic solutions.*

The other three *Versenes** are special purpose compounds for experimental, laboratory and pharmaceutical use. Technical information on request.

BERSWORTH CHEMICAL COMPANY
FRAMINGHAM, MASSACHUSETTS

Warehouse Stocks

Providence Agent: George Mann, 251 Fox Point Boulevard, Providence, Rhode Island
W. Coast Agent: Griffin Chemical Co., San Francisco, Los Angeles
Midwest Agent: Kraft Chemical Co., Inc., 917 W. 18th St., Chicago
Wasatch Chemical Co., Salt Lake City, Utah
Barada & Page, Inc., Dallas and Houston, Texas

Alcoa Heat Exchanger News

ALCOA ALUMINUM

PUBLISHED BY ALUMINUM COMPANY OF AMERICA

ALCLAD TUBES...a bargain in corrosion resistance

If you are troubled by the corrosion effects of sulfur compounds, oxygen, or carbon dioxide in cooling waters, alclad tubes offer a long-lasting solution.

Alclad tubes have given long service life in many fresh, brackish, and salt waters where high industrial contamination exists. Alclad tubes withstand waters having a wide pH range.

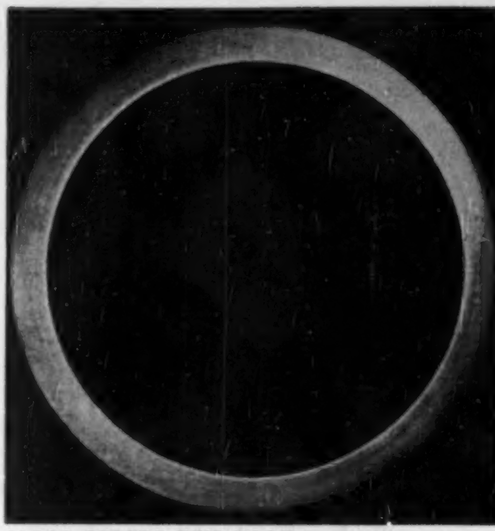
Coating Resists Corrosion

The zinc-aluminum alloy layer galvanically resists corrosion of the base aluminum alloy structure of the tube—acts like a "built-in" anode. Corrosion is confined within the integral cladding layer. Even when large areas of the alclad coating have been destroyed by electrolysis, the rest of the coating still continues to protect the exposed alloy core. Alclad tubes have withstood such corrosive attack for more than ten years, without failure.

Alclad Costs Little

The remarkable thing about alclad tubes are their low price. Foot for foot, metal for metal, they cost less than any other tubes except bare aluminum. Twenty per cent less than ordinary steel. Forty-seven per cent less than Admiralty. A sixth as much as stainless steel.

We'd like to tell you more about the savings possible with alclad tubes—amounting to thousands of dollars every month in many plants. Write to us. ALUMINUM COMPANY OF AMERICA, 1490M Gulf Building, Pittsburgh 19, Pennsylvania.



ALCOA OFFERS NEW BOOK This new, 24-page book will answer many of your questions about Alcoa tubes. It covers fabrication techniques, alloy selection, chemical and petroleum applications. It describes tube cleaning, inhibitors, cathodic protection. It contains complete information on fluid flow and heat transfer. There are formulas, tables, and specification data. Write for your free copy today. ALUMINUM COMPANY OF AMERICA, 1490M Gulf Building, Pittsburgh 19, Pa.

THESE APPLICATIONS ARE NATURALS FOR ALCLAD TUBES:

Petroleum

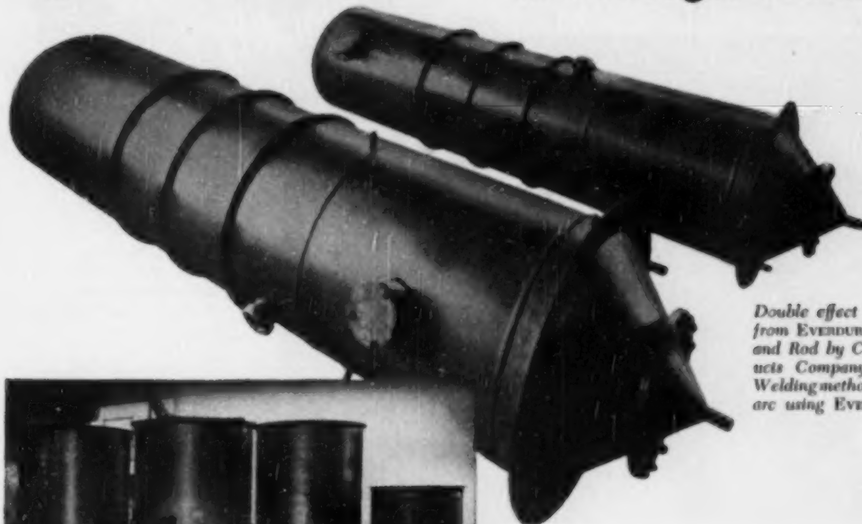
- Condensing of hydrocarbon fractions such as naphtha, gasoline, and gas oil
- Vapor-recovery condensers
- Lube-oil coolers
- Natural-gas compressor aftercoolers
- TCC overhead condensers
- Recompressor aftercoolers
- Hydrogen-sulfide gas coolers
- MEA-solution coolers and exchangers
- Furfural condensers and exchangers
- MEK service
- Propane chilling
- Wax sweaters
- Depropanizer overhead condensers

Chemical

- Butanol
- Ethanol
- Ethylene Glycol
- Glycerin
- Hydroabietyl
- Isopropanol
- Methanol
- Phenol
- Propylene Glycol
- Acetaldehyde
- Formaldehyde
- Acetic Acid
- Butyric Acid
- Stearic, Palmitic, Oleic Acids
- Recinoleic Acid
- Acetanilide
- Ammonia and Ammonium Hydroxide
- Hydrogen Cyanide
- Nitric Acid (concentrated)
- Pyridine
- Hydrogen Sulfide
- Benzene
- Benzol
- Dichlorobenzene
- Gasoline
- Gelatin
- Hydrogen Peroxide
- Methyl Ethyl Ketone
- Turpentine

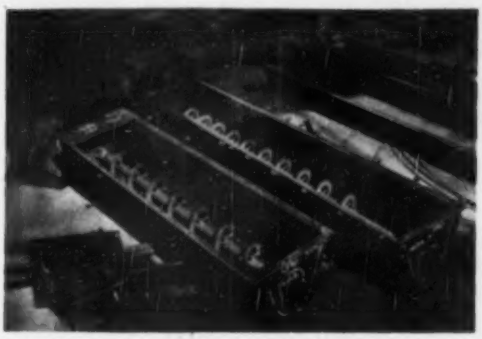
These listings cannot cover the many hundreds of other chemicals with which aluminum tubes can be used

Everdur does a "sweet" job in this sugar refinery



Double effect calandria fabricated from Everdur *Plate, Circles, Pipe and Rod by California Steel Products Company, Richmond, Calif. Welding method: inert-gas-shielded-arc using* Everdur *Welding Rod.*

Tanks for storing sugar syrup. Made of ⅛ in. Everdur *Sheet. Removable covers are also* Everdur. *Built by Iron and Steel Contracting Co., San Francisco.*



Screw mixer and conveyor made of Everdur *Sheet, Pipe and Rod, inert-gas-shielded-arc welded using* Everdur *Welding Rod. Fabricated by McDonough Steel Products Co., Oakland, Calif.*

*Reg. U. S. Pat. Off.

Sugar liquors are corrosive in certain stages of processing. And it is extremely important that there be no contamination from contact with metals.

Naturally, therefore, Everdur* is widely used in sugar refining equipment. Strong, tough, non-rusting, resistant to corrosion, and easily shaped and welded by standard methods and equipment, Everdur is a dependable, profitable material for a wide range of process industry equipment.

The equipment shown on this page was recently built for the Spreckels Sugar Company for installation in its large beet sugar refinery at Spreckels, Calif.

Our Technical Department has extensive data on specific applications of Everdur in many process plants. We shall be glad to discuss these in connection with your own process equipment problems. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Limited, New Toronto, Ontario.

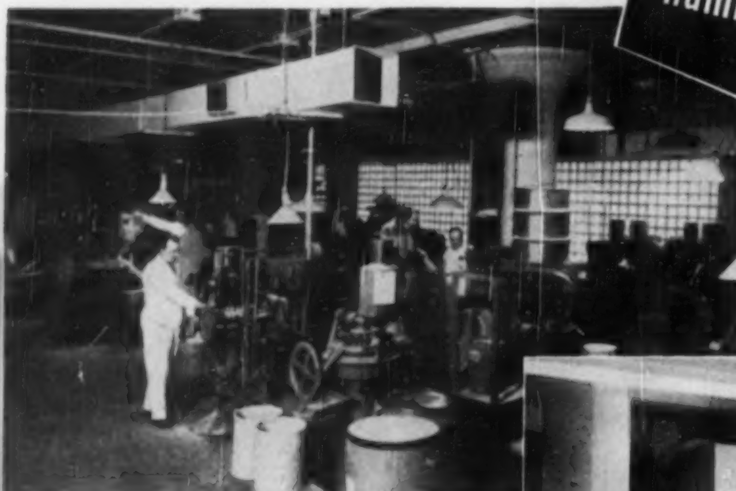
Where corrosion resistance counts — use *Everdur*

ANACONDA®

COPPER-SILICON ALLOYS

Rexall 300 MILLION TABLETS A MONTH...

with the help of Lectrodryer humidity control



Below: This type CHR Lectrodryer maintains 30% relative humidity in this tableting room the year 'round.

Night and day, seven days a week! That's the schedule on which this Lectrodryer works, holding the humidity constant—one of the many precautions Rexall Drug Company takes to insure constant quality of the tablets made here.

Elsewhere in this plant, two Type C-150 Lectrodryers—long since superseded by the Lectrodryer shown above—are at work. Installed first in Boston in 1938, they were later moved here to St. Louis. They go about their DRYing job faithfully and efficiently, unaware of the fact that they are grandparents.

You can depend on Lectrodryers to DRY air, gases and organic liquids—large quantities or small, atmospheric pressure or up to 5,000 psi., to dewpoints below -110° F. Quite likely, there's a standard Lectrodryer ready to step out of our catalog into your plant.

Let Lectrodryer engineers help you determine what type and size you need. Tell us your DRYing problem. Pittsburgh Lectrodryer Corporation, 303 32nd St., Pittsburgh 30, Pa.

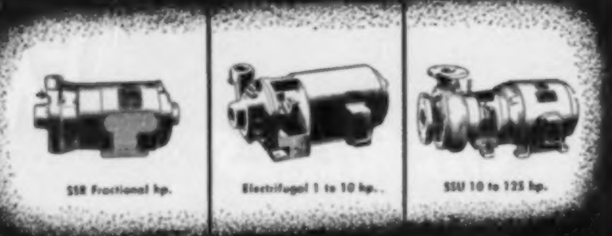
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U. S. PAT. OFF.

ALLIS-CHALMERS PACKAGE PUMPS



Plenty of room for maintenance

LOOK AT THE SPACE between the pump and motor on this *Electrifugal* pump. Packing maintenance or replacement is quick and easy, yet rigidity of the frame has not been sacrificed. You save time and money on maintenance. You get a better packing job because your maintenance man has room to work.

Maintenance procedures on bearings have been eliminated altogether. Bearings are sealed with just the right amount of the correct grease. They cannot be over or under lubricated. Bearings are protected from liquid by a new type of double bearing seal that excludes all liquid under any normal operating condition.

All cast iron frame construction for rigidity and corrosion resistance . . . smooth contours for pleasing appearance and easy cleaning . . . replaceable wearing rings . . . shaft sleeves . . . are other high quality features that make A-C package pumps deliver low cost per gallon pumped.

COORDINATED DESIGN

Pumps and motors are designed, built, assembled and tested in the same plant to work together to give you more for your pump dollar. Competent application engineers help you select exactly the right pump for your needs and a nation-wide network of Certified Service Shops helps you keep your pumps in top condition.

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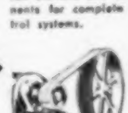

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These seven Joy compressor illustrations and their dates tell a story of design leadership in the compression of air and gases. Here, we believe, is visual proof of the part Joy has played in the progressive development of compressor design and construction.
We are justly proud of this heritage and what it means. The design of our WN-112 and WN-114 is years ahead of the field, offering greater economies and higher efficiencies to the modern user of air power. We know because we have designed and built them all.
1885 TYPICAL JOY VERTICAL OF 65 YEARS AGO
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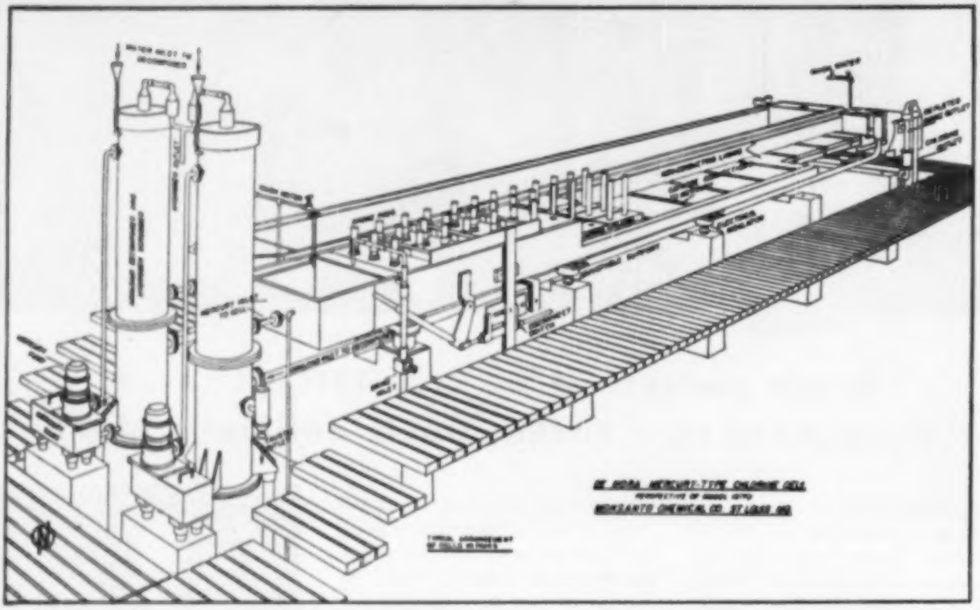
For Your Information

Every month Monsanto publishes these pages of pertinent information. Here you will find suggestions and application ideas selected to help you improve your products, lower your production costs, increase your sales. More information will gladly be furnished on request.



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If you would like to know more about the Monsanto Electrolytic Chlorine Process write or wire Monsanto Chemical Company, Engineering Sales Department, 1700 South Second St., St. Louis 4, Missouri.

Mail coupon for bulletin on Monsanto Plasticizers

If you manufacture polyvinyl chloride film and sheeting, you will find Monsanto Technical Bulletin No. O-70 interesting and profitable reading. The 11-page bulletin gives the properties and uses of typical formulations, detailed information on various plasticizers and their functions and the composition and relative values of seven stabilizer systems. For your free copy of Technical Bulletin No. O-70, "Monsanto Plasticizers in Polyvinyl Chloride Film and Sheeting," indicate your wishes on the coupon and mail it to Monsanto.

Application research expanded at Monsanto

Monsanto's research in the application of chemicals to other industries has been expanded with the creation of a special section in the Organic Division Research Department to carry on such work. Present application research deals with plasticizers, agricultural chemicals and oil additives. In the future, projects will be handled in all fields served by the hundreds of Monsanto Chemicals.

Monsanto's nontoxic plasticizers have many uses and possibilities

The development of nontoxic plasticizers has opened new horizons for plastic products, including coatings, adhesives, films, sheeting, extrusion articles and molded items. In the Monsanto line of plasticizers, all of which are in limited supply, are three Santicizers that have been accepted as nontoxic by the Bureau of Animal Industry of the United States Department of Agriculture. These nontoxic plasticizers are Santicizer* 141, Santicizer B-16 and Santicizer E-15.

The list of applications of these Santicizers may suggest uses helpful in your business. If, after reading the list, you want further information, mail the coupon or contact the nearest Monsanto Sales Office.

Applications of nontoxic plasticizers include:

COATINGS

Paper—Greaseproof coatings for doughnut packages, ice cream cartons, paper plates, cap linings for beverage bottles.

Metal—Can linings.

Cloth—Upholstery or other fabric applications where skin contact may result in irritation.

ADHESIVES

Paper—For fabricating leakproof containers such as milk cartons, orange drink bottles and similar products.

Metal—Can-sealing compounds for containers such as lard cans.

FILMS AND SHEETING

Plasticized Film Packaging—For packaging such items as fresh meat, frozen meat, prepared and cured meat, poultry, cheese (both natural and processed), butter, margarine, lard and shortening, candy, vegetables and fruits (both fresh and dried), bulk produce (such as apples, cranberries, potatoes, grapes), staples (such as flour).

Nonirritating Items—Baby pants, hospital sheeting, household scrub gloves.

EXTRUSION ARTICLES

Tubing—Venoclysis (blood transfusion) tubing, milk and beer tubing.

MOLDED ARTICLES

Prosthetic Devices—Artificial ears, fingers, etc., gum dentures, nontoxic sponges.

Try Sterox CD—low-sudsing, 100%-active, nonionic, synthetic detergent and wetting agent

Take a look at Monsanto Sterox* CD when your industrial processes call for a low-sudsing, 100%-active detergent or wetting agent or when you are developing detergent mixtures for home or commercial use. If you want to try Sterox CD in your laboratory, we'll be glad to send you a sample and answer any questions that you may have.

Sterox CD is a pale-yellow to light-amber liquid with a mild odor that is not objectionable but which can be perfumed easily if desired. At room temperature, Sterox CD is of medium viscosity, having a pour point of approximately 50° F. It is miscible with water in all proportions at room temperature.

Sterox CD is efficient in hard or soft water. It is compatible with synthetic detergents and soaps. It frequently is advantageous to add Sterox CD to anionic detergents. Sterox CD is compatible with cationic-type detergents and gains increased efficiency when combined with such builders as phosphates, silicates and carbonates. It is used effectively with acid-type cleaners.

The addition of small amounts of Sterox CD to dry detergent mixtures will substantially reduce dusting during the mixing operation and in the finished product.

For complete data and a sample for use in your laboratory, mail the coupon or contact the nearest Monsanto Sales Office.

New isocyanate

Ethyl isocyanate has been added to the extensive line of isocyanates available from Monsanto. Isocyanates are used in adhesives, paint, rubber, plastics and textiles. Mail the coupon for data.

Santomerse No. 1... all-purpose detergent and wetting agent

Santomerse* No. 1 is the all-purpose detergent and wetting agent. It is a versatile servant that disperses, wets, emulsifies, penetrates, and is high in detergency. As a detergent, Santomerse No. 1 has the ability to lift out particles of grime and grease and hold them in suspension so they can be carried away in the rinse. Effective in hard or soft, hot or cold water and in alkaline, neutral or acid solutions, Santomerse No. 1 does not form insoluble soap curds, which are detrimental to industries such as textile manufacturing.

AROCLORS put "protection" in protective coatings

Used as plasticizers or resins by many leading manufacturers of modified and synthetic rubber protective coatings, Monsanto Aroclors deliver greater toughness and adhesion . . . stronger resistance to corrosion, flame, water and weather . . . greater resistance to acids and alkalies. There probably is an Aroclor* you can use in your paints. Mail the coupon for details.

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Monsanto Intermediates

The following intermediates are available from Monsanto:

Dinitroaniline
Metachloraniline
Methyl Para Toluenesulfonate
Monsanto Salt
Orthochloraniline
Orthochlorophenol
Orthonitrobiphenyl
Orthoaminobiphenyl
Parachloraniline
Toluenesulfonic Acid

Limited supplies are available on certain other Monsanto Intermediates and prompt shipment may or may not be possible. If you need any of the following intermediates, contact the nearest Monsanto Sales Office for the latest information on availability:

Benzoic Acid
Benzyl Chloride
Parachlorophenol
Paranitrochlorobenzene
Paraphenetidin
Paratoluenesulfonchloride
Paratoluenesulfonamid
Phenol
Phosphorus Oxychloride
Phosphorus Trichloride
Salicylic Acid Technical
Dinitrochlorobenzene
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SEND SAMPLE: ☐ Sterox CD.

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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

Prepared under the editorial direction of Joseph A. O'Connor, News Editor

Alcohol: new year's big headache

BIG DEMAND—During 1951, the government estimates, 350 million gallons of ethyl alcohol will be needed for all purposes. In 1951, the government is expected to need 140 million gallons, or about 70 percent of total productive capacity of distillers, for the synthetic rubber program alone. Other big uses: smokeless powder, chemical warfare materials, and fuel for rockets and guided missiles.

NOT ENOUGH MOLASSES—An anticipated shortage of molasses, a vital basic, is troubling the alcohol producers. They fear Cuba, major supplier of molasses, won't ship enough in 1951 for military demands—including expanded production of synthetic rubber.

To get the 350 million gallons of alcohol needed for all purposes next year, the industry figures it will need some of the molasses that is going into other uses. Obvious target of any priority system would be the livestock feed makers, the other major users of molasses.

FRENCH ALCOHOL—Reports that RFC's Office of Rubber Reserve has agreed to purchase 112 million gallons of French alcohol for production of butadiene in the U. S. have started a ruckus. The price over there is said to be about 48½ c. per gal. Actual delivery, duty paid, at the U. S. butadiene plants may come to 60 or 70 c. or perhaps even higher.

UPROAR—Amid the welter of charges and countercharges, these are some of the arguments raised:

France will have to build plants to fill the U. S. order; she will use up her entire sugar beet crop; to meet her own alcohol requirements, she may have to import cane sugar from Cuba through ECA.

French alcohol on delivery in the U. S. will cost more than U. S. alcohol even at its present high price.

The U. S. government, through the Production & Marketing Administration and the Commodity Credit Corp., is buying and destroying potatoes that could be a source of industrial alcohol. Meanwhile, U. S. plants like Publicker's in Philadelphia that had been converted to potato distillation—having been refused potatoes by the government—have been reconverted to process grain and are now running at capacity. However, groups in New York are reported to be dickering for the plant of Atlas Processing Co., Maine's only potato alcohol distillery, shut down since early 1949.

Either government-owned surplus grain or unsalable immature Iowa grain could be used by U. S. distillers to produce the quantity of alcohol to be imported from France. This would save money for U. S. taxpayers. Democratic Senator Guy M. Gillette has called for an investigation. His corn-raising Iowa constituents are currently raising Cain.

CONTROLS LIKELY—Upshot of the whole situation is that the National Production Authority is expected to slap controls on industrial alcohol producers.

Du Pont signs AEC contract

Urged to do so by the Atomic Energy Commission, Du Pont has signed a contract covering the design, construction and operation of new production facilities for atomic materials. The AEC states that products to be made at the new installation "will be used in carrying out President Truman's directive of Jan. 31, 1950, that the Commission continue its work on all forms of atomic weapons." The project is big; it will call for an effort as great as that Du Pont made in carrying out the Hanford project in World War II.

Du Pont did not seek this assignment. It was accepted only when the highest government officials insisted upon the vital importance of the project to the security and defense of the United States. They also urged the job on Du Pont because it had the technical personnel, resources and experience to undertake this great task.

When it withdrew from the Hanford operation in 1946, Du Pont wanted to get out of the atomic energy field for keeps. It preferred to concentrate on the chemical business, leaving the peacetime development of atomic energy to companies whose commercial interest was more closely allied with the field of physics. This is still Du Pont's position. But in the interests of national security, it has again placed its experience and technical resources at the disposal of the government by undertaking this new project.

At Du Pont's request, the new contract provides that the government pay all costs, that Du Pont receive a fee of $1, and that any patents growing out of Du

(*Continued on page 68*)

Pont's work become the property of the U. S. government. The Hanford project was undertaken on a similar basis.

The new project will entail the detachment from their present duties of many Du Pont management and technical personnel. The compensation of these individuals will, of course, be paid by the government. But their withdrawal from commercial operations will constitute a substantial contribution by Du Pont.

Chemstrand to make nylon?

OFFER—Du Pont is negotiating to license Chemstrand Corp. to produce and sell nylon yarn. Nylon is manufactured in several foreign countries, but negotiations with Chemstrand are the first with a U. S. company. Hitherto nylon has been the exclusive product of Du Pont in this country.

ENTIRE PROCESS—Chemstrand, jointly owned subsidiary of Monsanto and American Viscose, would produce the fiber independently of Du Pont. It would control the entire nylon yarn process, beginning with the manufacture of the intermediates, hexamethylene diamine and adipic acid, and ending with the production of the finished nylon fiber.

DEMAND FOR NYLON—"Increasing acceptance of nylon," according to a Du Pont spokesman, "has outpaced Du Pont's plant capacity despite an extensive expansion program, launched before the end of the war, that has tripled production."

Hence, with an eye on its other interests and commitments in a diversified chemical business, Du Pont has decided "to broaden and accelerate the effort to meet the unsatisfied demand for nylon fiber." The growing demand for nylon has been estimated at over 200 million pounds yearly.

OTHER DIVESTMENTS—Licensing of nylon manufacturing rights would be another in a series of instances in which Du Pont products have been made by others as a result of corporate divestments and patent licensing arrangements.

Such divestments resulted in the creation of Hercules Powder Co. and Atlas Powder Co. more than 20 years ago. More recently, Du Pont has licensed other firms to make important products of which it was sole maker. Among them: metallic sodium for tetraethyl lead and cellophane. Olin Industries has been licensed to make cellophane in a new plant, utilizing Du Pont patents and know-how.

CAPITAL OUTLAY—Chemstrand was organized over a year ago to make a new synthetic acrylic fiber, and has under way plans for a multi-million dollar plant at Decatur, Ala., to make the fiber. Nylon would be made in addition to the new acrylic fiber, if negotiations with Du Pont are concluded, according to Osborne Bezanson, new Chemstrand president.

This is going to take plenty of capital. But Chemstrand, backed by Monsanto and American Viscose, should be able to ante up the money. It's estimated the nylon venture will require an investment of up to $50 million.

Big potash discovery in Britain

A discovery that will save the United Kingdom about $10 million in annual potash import expenditures during at least the next 140 years has been made in northeast Yorkshire.

The 200-million-ton potash discovery has been made known by Alexander Fleck, a director of Imperial Chemical Industries. Britain has been importing her annual requirement of 250,000 tons of potash, used to manufacture agricultural fertilizers, explosives and potassium salts for the chemical industry, from the United States, France and Spain.

Borings during the last two years established the existence of the deposit. It contains enough potassium chloride to meet Britain's needs for a long time. It will lead to the establishment of a vital new British industry. Dependence on foreign sources of supply—estimated at $10.8 million a year—will end.

So far, at least 200,000 tons of potassium chloride have been found within a survey area of 12 sq. mi. Years of research and field work have been shrouded in the closest secrecy until now.

New catalytic reforming process

Reforming of petroleum stocks by a new process that employs an improved catalyst may be one way to ease the benzene shortage. Atlantic Refining has come up with the process and Davison Chemical will manufacture the catalyst.

The new method increases the yield of higher quality gasoline. This process and catalyst, according to Vice President R. L. Hockley of Davison, "appear to be a substantial improvement over other recently widely publicized reforming processes and could have a very important part to play in helping overcome the current benzol shortage in the U. S. We anticipate this process and catalyst will be widely used in petroleum refining in the very near future."

More manganese dioxide

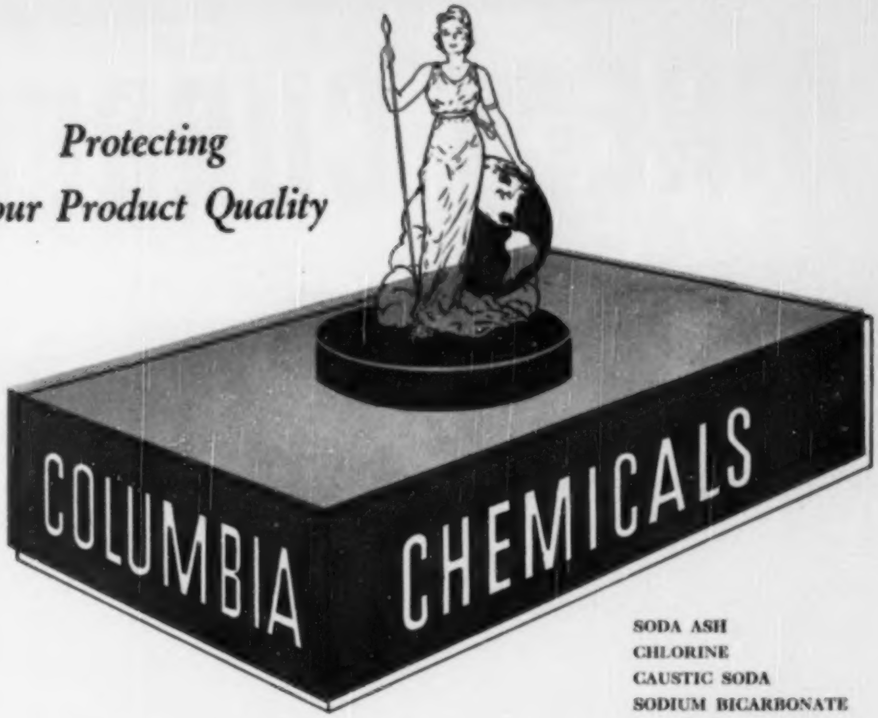
Two new producers, one in Oregon and the other in Nevada, are to turn out manganese dioxide. Most of it will go to battery manufacturers with contracts from the U. S. Army Signal Corps.

Continental Chemical Co. is already producing manganese dioxide in the Salem, Ore., plant that it leased from the government early in 1950, when it began making ammonium sulphate. At capacity, the plant is expected to turn out 200 tons of manganese dioxide per month. Ore comes to Salem from mines in northern California and in Nevada.

How it makes the dioxide has not been disclosed

(*Continued on page 72*)

Protecting Your Product Quality



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When you use Columbia chemicals, you protect the quality of your products. A background of more than fifty years experience enables Columbia production technicians to employ controlled methods and supervision that assure chemicals which meet your most exacting standards.

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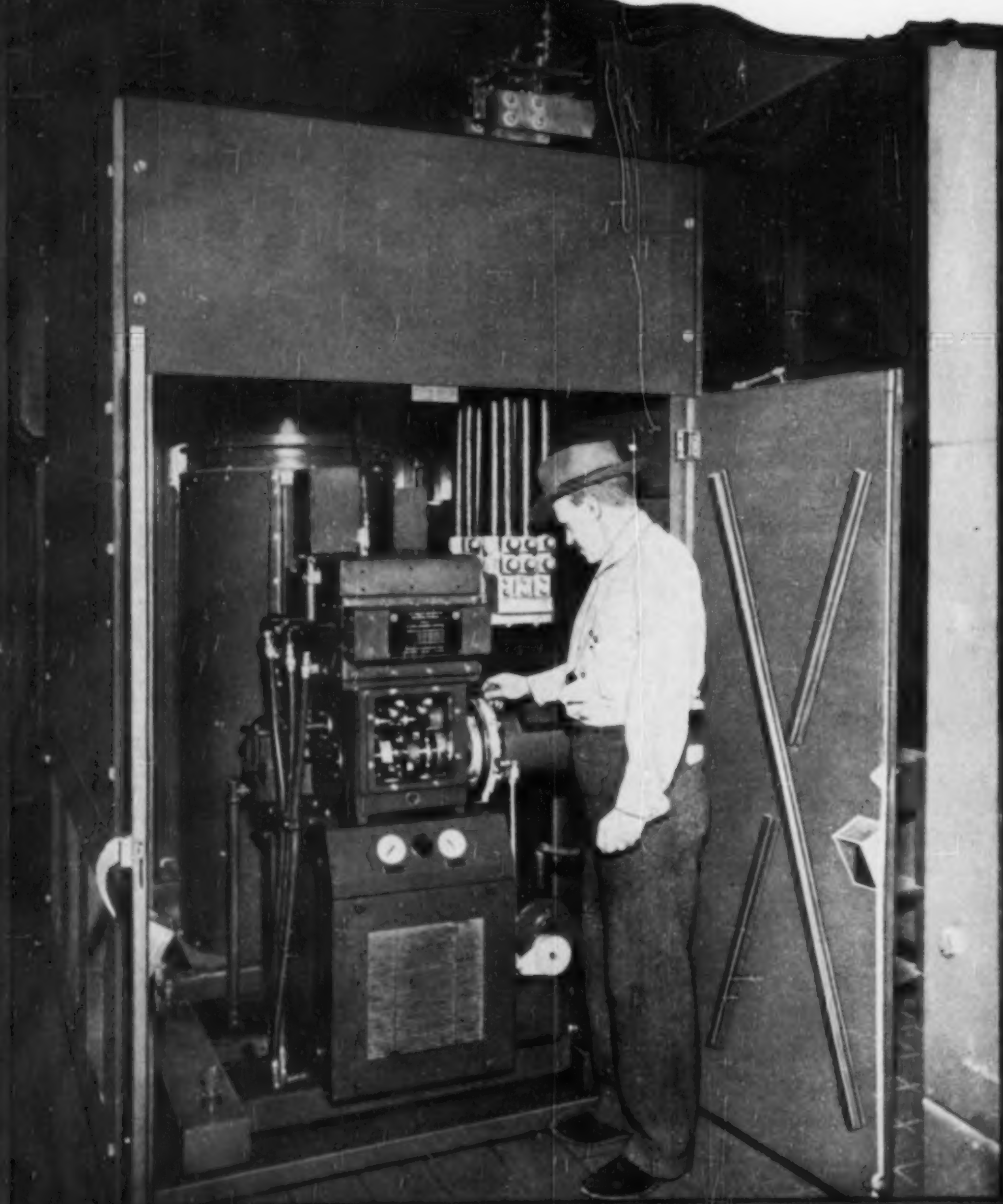

USERS–

HERE'S NEWS FOR *You!*

BUFFALO ELECTRO-CHEMICAL ORDERS THIRD AND FOURTH I-T-E MECHANICAL RECTIFIERS

Here in a nutshell is the power conversion news of the year! After pioneering the first mechanical rectifier installation in the U.S.A., the management of Buffalo Electro-Chemical Company, Inc., Buffalo, N.Y., again has chosen the I-T-E Mechanical Rectifier to furnish power for a modernization program.

Deciding factors in Buffalo's decision were the mechanical rectifier's high inherent efficiency, small space requirement, low maintenance cost, and ease of operation.

The two original rectifier units, both rated at 3500 amperes, 260 volts d-c, have given 96.6% effici... their installation ea...

MORE INDUSTRIAL ORDERS FOR MECHANICAL RECTIFIERS

Further power conversion news has been made by the following companies who have placed orders for their first I-T-E Mechanical Rectifiers.

GENERAL MOTORS CORP.
Janesville, Wisc.

•

HERCULES POWDER CO.
Hopewell, Va.

•

SUPERIOR GAS & EQUIPMENT CO.
Philippine Islands

•

U. S. METALS REFINING CO.
Cartaret, N. J.

•

MARATHON PAPER MILLS OF CANADA, LTD.
Marathon, Ontario, Canada

•

IMPERIAL CHEMICAL INDUSTRIES, LTD.
Cheshire, Runcorn, England

•

PENNSYLVANIA SALT MFG. CO.
Wyandotte, Mich.

•

FIELDS POINT MANUFACTURING CORP.
Providence, R. I.

These companies join the growing list of users of the mechanical rectif... The many adv...

I-T-E

by Continental. However, it's likely that the process is something like this: low-grade ore is leached with sulphurous acid; then the resulting solution of manganous sulphate and sulphuric acid is treated with ammonia and agitated with air; this yields ammonium sulphate and hydrated manganese dioxide.

The other producer is Western Electrochemical Co. at Henderson, Nev., where a multi-million dollar expansion is under way. More electric power from the Colorado River Commission made the expansion possible. Production of manganese dioxide is scheduled to begin in February at Henderson.

Process that Western will use to make dioxide for batteries from low-grade manganese ores is called the Schumacher process. It was carried through the pilot-plant stage at the company's research laboratories near Los Angeles, where J. C. Schumacher directs research.

Meantime, Western Electrochemical, already the world's largest producer of chlorate and perchlorate chemicals, will increase production of these latter compounds at Henderson. It manufactures sodium chlorate, potassium chlorate, potassium perchlorate, ammonium perchlorate and manganese sulphate at the Nevada site. Decision to expand came because chlorates and perchlorates are needed as fuel components for military planes and projectiles. Chlorate production will be stepped up first, 202 electrolytic cells being added for this purpose.

Coal hydrogenation: source of aromatics

Current shortages and increasing requirements for chemicals have, according to Bureau of Mines Director James Boyd, focused attention on the coal hydrogenation process. Benzene and aromatic hydrocarbons generally, together with phenol and other commercial tar acids, can be produced in substantial amounts by the direct hydrogenation of coal.

A single 30,000-barrel-a-day coal hydrogenation plant, producing principally gasoline and liquefied petroleum gases, could ease the shortage of aromatics.

Estimated annual yield of a plant of this size would include, for example, 34 million gallons of benzene, 49.5 million gallons of toluene, 50.3 million gallons of xylenes, 34.5 million pounds of phenol, 57 million pounds of cresols and 75 million pounds of xylenols. This is equivalent to nearly 20 percent of the nation's 1948 production of benzene and 11 percent of the 1948 phenol output (1949 was not typical because coal strikes curtailed production of these chemicals in coke plants).

In addition, this plant would produce as major products 3.5 million barrels of motor gasoline and 3.25 million barrels of liquefied petroleum gases.

Yields of benzene, toluene and xylenes from such a plant could be increased 25 percent by recycling the higher-boiling fractions. This, of course, would reduce proportionately the yield of gasoline.

New Platforming units

Shell Oil Co. will construct two Platforming units, largest of their kind ever built, to increase the supply and quality of motor gasoline and at the same time maintain top production of petroleum products vital to civilian and military needs.

Contracts for the units have been signed with Universal Oil Products Co., which will handle engineering and design. Actual field construction will be done by Procon, Inc., a newly formed subsidiary of Universal Oil Products. The units are expected to be completed in the fall of 1951.

Each Platforming unit will process low-quality naphthas at the rate of 630,000 gal. a day into high-octane components for gasoline. One unit will be built at Shell's Wood River, Ill., refinery and the other at Houston, Tex. Each will cover an area the size of a city block.

First butadiene unit on stream

First of the standby petroleum butadiene plants of the government to be reactivated under the synthetic rubber production program has started production at Houston, Tex., just 15 days after the introduction of feed stock. Sinclair Rubber, Inc., operates the plant for RFC's Office of Rubber Reserve.

Except for the power unit, the Houston plant has been in standby since late in 1947. Ordered reactivated by Rubber Reserve in July, the plant, second biggest in the nation, has been completely renovated, including fractionating towers, tanks, pumps, turbines, motors, valves and piping.

When operating at capacity, the annual production of butadiene will be about 75,000 tons. It will be delivered to the adjacent copolymer plant run by Goodyear Synthetic Rubber Corp.

New synthetic rubber process?

General Tire & Rubber Co. claims to have a new synthetic rubber process that would increase output of present plants by 22 percent, with further increases later. The process involves the addition of new materials developed by General Tire and a method of introducing them into the present synthetic rubber process. None of the new materials is scarce.

Tires that it has already made from rubber produced by the new process are superior to those made from present synthetic rubber, according to General Tire.

The process has been offered to RFC by General Tire. There's one snag, however. General Tire wants to be paid for the process. This despite contract provisions that give the government the right to any new developments arising from management by private concerns of federal synthetic rubber plants. General

(Continued on page 74)

Whether you want one worm-gear speed reducer or a thousand, a standard drive or a unit designed to meet special problems, Cleveland can serve you better.

"Cleveland" is the standard in worm gearing

● When you specify "Clevelands—or equal," you can be confident that you are getting the finest in worm-gearing.

The uniform dependability that has distinguished Clevelands through 38 years has established "Cleveland quality" as the measure of value in worms and gears. Cleveland sets the pattern through four outstanding features:

1. *Correctness of design*—proved by years of performance.
2. *Finest of materials*—selected on the basis of long experience and research.
3. *Modern manufacturing facilities*—kept up-to-date by a policy of continuous replacement.
4. *Precision workmanship*—by machinists and other production workers, trained as craftsmen.

Cleveland offers a complete line of worm gear sets and speed reducers, including the popular fan-cooled Speedaire—to meet the needs of any machinery or equipment builder or user. Representatives in all major industrial centers are at your service. Write for our current catalog.

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Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Drives

Tire operates one of RFC's synthetic rubber plants at Baytown, Tex. The legal snarl has still to be untangled.

Payment in rubber is what the company wants for turning its process over to RFC. If the government doesn't come through, General Tire may use the process in a synthetic rubber plant it now has under construction. President William F. O'Neill says the process would produce 18,000 tons of synthetic annually in the new plant, which is designed to produce 10,000 tons yearly using present methods.

Aluminum plants for Gulf Coast?

The Gulf Coast of Texas and Louisiana looks mighty enticing these days to the kingpins of the aluminum business. Scouts from Reynolds, Kaiser, Apex Smelting and National Aluminum Products have been fine-combing the area for sites for possible new alumina and aluminum metal plants. One big attraction of the Gulf Coast: its tremendous supply of cheap natural gas.

Alcoa, meantime, will increase capacity of its Point Comfort Works at Point Lavaca, Tex. Built a year ago, the plant was so designed that expansion will not be difficult.

Chlorine plant to use De Nora cells

First big chlorine plant in the U. S. or Canada to use De Nora mercury cells with a rated capacity of 30,000 amp. will be erected by Marathon Paper Mills of Canada, Ltd., as the result of a contract signed recently by Marathon, the Leonard Construction Co. of Chicago and Monsanto Chemical Co.

The plant, to be located at Marathon, Ontario, will be built to produce 25 tons of chlorine per day. Designed by Monsanto, the plant will be erected by the Leonard Construction Co. It will manufacture rayon-grade caustic soda, chlorine, electrolytic sodium sulphide, sodium hypochlorite and synthetic hydrochloric acid.

In September 1948, Monsanto disclosed a tentative agreement with Dr. Oronzio De Nora, head of an Italian company, for the use and sale of the De Nora mercury cell in the U. S.

First ammonia plant in Northwest

Hooker Electrochemical Co. will build at Tacoma, Wash., the first anhydrous ammonia plant in the Pacific Northwest. Slated for completion early in 1952, the plant will cost an estimated $2 million.

Hydrogen for the ammonia plant will be byproduct hydrogen from Hooker's chlorine-caustic operation at Tacoma. In a $3 million expansion program, recently completed, Hooker replaced older caustic cells by the new Type S-3 ones, thus materially increasing production of caustic and chlorine, and getting at the same time more byproduct hydrogen.

The ammonia will be produced for the growing requirements of the pulp and paper industry and the chemical industries of the Pacific Northwest.

Pressure on polystyrene molders increases

About one-third of the 900 plastic injection molders throughout the country face financial ruin because of the shortage of polystyrene plastic molding powders, reports SPI's Elmer Mills, chairman of the injection molders' committee on national security. The styrene, of course, is being syphoned off by the reactivation of synthetic rubber plants.

During the summer, plastic raw material manufacturers, operating at practically full capacity, produced 75,185,000 lb. a month of all kinds of plastic molding powders. Of this total, 23,138,000 lb. was polystyrene, which is being cut back to 17 million pounds a month for molding purposes. This compares with anticipated requirements of 30 million pounds a month when all of the new molding equipment now being installed is in operation within a few months.

"As allocations for polystyrene plastic raw materials are based on last year's requirements," Mills points out, "many firms are not receiving enough polystyrene molding powder for their present operations and none for their expanded capacity. New injection molding plants are not receiving any polystyrene molding powder because they have no purchasing background from last year."

Chemical unions put bite on members

Costs are rising for unions, too. Both CIO and AFL chemical unions at their recent conventions raised to $1 the per capita tax payments they collect per month from local unions. Previous tax: 75 c. District 50 of the United Mine Workers collects $1.50.

New jobs in government rubber plants

An estimated 5,000 new jobs will be created by the government's decision to reopen all of the nation's facilities for producing man-made rubber, some of which have been closed down since shortly after the end of World War II, according to William S. Richardson, president of B. F. Goodrich Chemical Co.

"The program for producing 929,000 long tons of man-made rubber of all types, scheduled to be accomplished early in 1951, will put an additional demand on American industry's technical man-power," Richardson says.

Goodrich, largest producer of American-made rubber during World War II, has the responsibility of producing 150,000 long tons of rubber in the new government program. Goodrich, which now operates a government copolymer plant in Port Neches, Tex., with a design capacity of 60,000 tons, will reopen and operate the government copolymer plant at Institute, W. Va., having a design capacity of 90,000 tons.—*End*

Cut Materials Unloading Costs 2 Ways

ALLIS-CHALMERS CAR SHAKER

1. SAVE TIME MAN-HOURS

In a few minutes a hopper-bottom carload of bulk chemicals or other granular materials can be emptied with the new Allis-Chalmers Car Shaker. Labor is saved at the unloading station. Expensive demurrage costs may be avoided!

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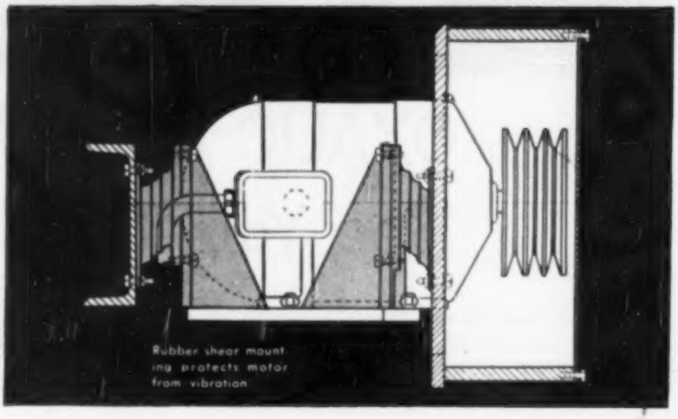
Simplified mechanism has minimum of working parts to maintain. Driving motor is 15 hp, high-torque, totally-enclosed... mounted on rubber to protect against vibration! (Note rubber motor mount at right) Steel body is stress-relieved.



HERE'S A CAR SHAKER that is built to withstand severe vibration necessary for fast unloading of bridged and packed materials from hopper-bottom cars.

Its simplified mechanism . . . its unique arrangement for hydraulically removing self-aligning bearings for replacement purposes . . . and *many* other features pay off in low maintenance and long service!

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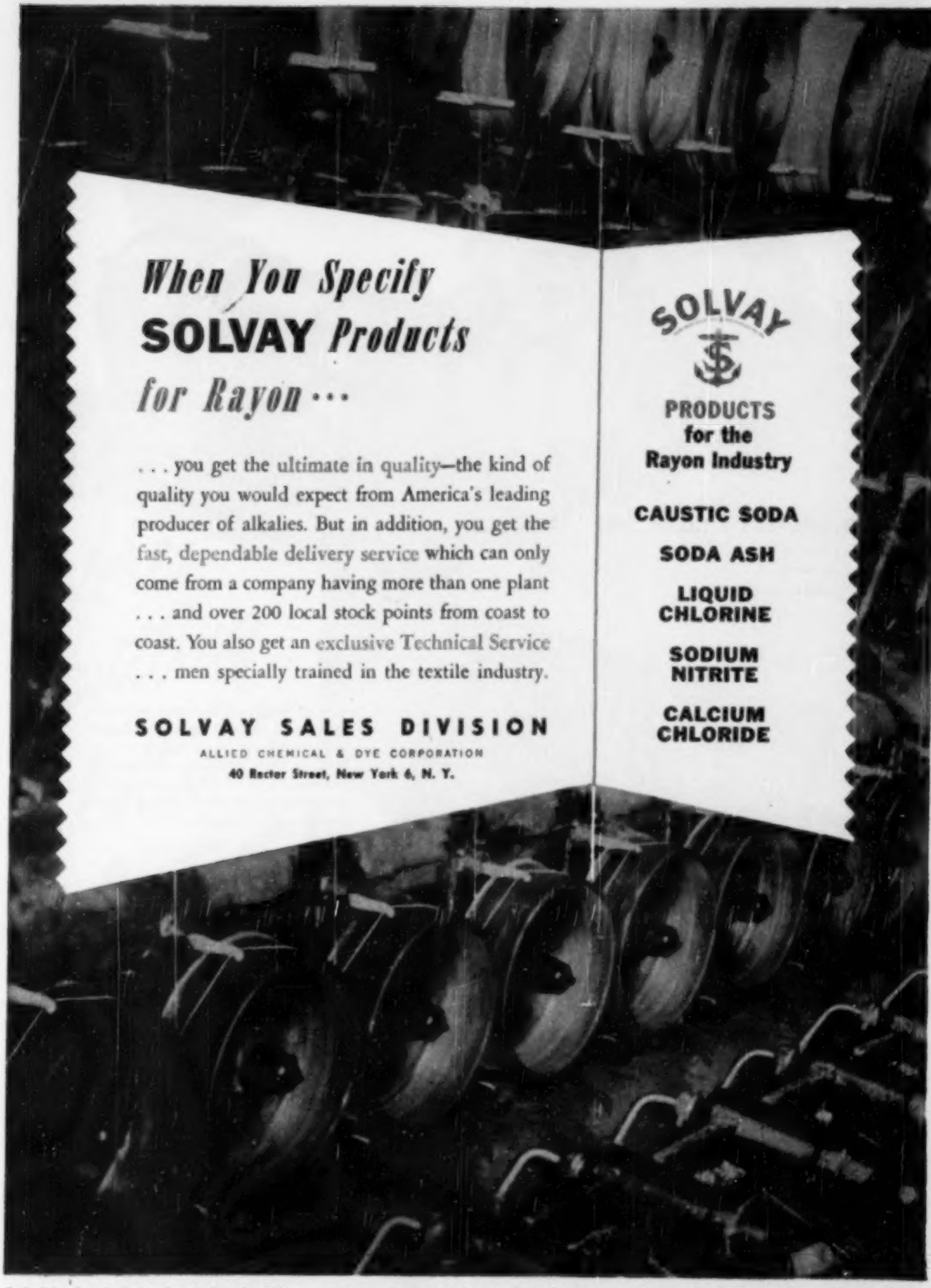

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The plastics industry may well pride itself upon the tireless research, creative imagination and aggressive promotion which have boosted plastics production 600 per cent in the last 10 years.

We at Barrett, too, take pride in our own contributions to this colorful new world of plastics. Over the years we have kept the industry supplied with a vast and growing stream of basic chemicals and plasticizers. For some of these, we are the world's principal supplier.

Helping businesses like the plastics industry to prosper has made Barrett "one of America's great basic businesses."

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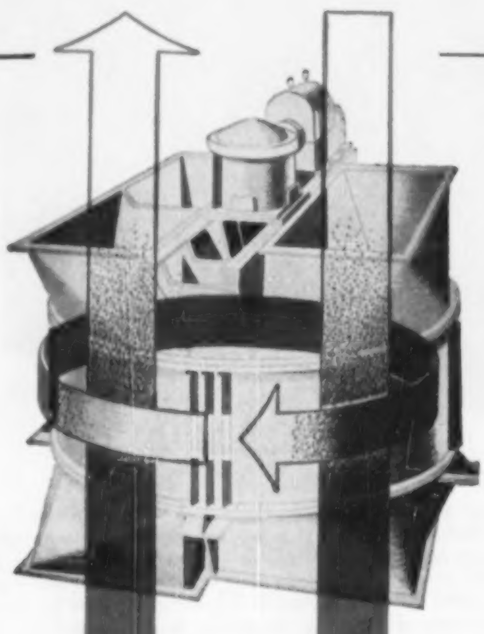
"ELASTEX" DCHP Plasticizer • Dibutyl Phthalate • Phthalic Anhydride • Phenol • Crystal Urea

Increase the efficiency of your present boiler

with the *Ljungstrom* AIR PREHEATER



The installation of a Ljungstrom air preheater on your present boiler offers the opportunity for considerable fuel savings that will more than offset the initial cost of the preheater in a matter of a few years.

The regenerative counterflow principle of the Ljungstrom permits operation at lower exit gas temperatures . . . assuring increased heat recovery and reducing the amount of fuel required. Moreover, the compactness and lightness of the preheater makes it possible to install it on your present boiler with minimum change in the existing structure.

For more information as to how you can approach modern performance standards with a boiler that is operating without an air preheater, or with out-of-date air preheater, write to the Air Preheater Corporation. Our engineers will welcome the opportunity to show you how the Ljungstrom can raise the over-all efficiency of your plant.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER CORPORATION

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a new and proven tool in metallic and non-metallic minerals and chemical processing

the DorrClone*

(DUTCH STATE MINES CYCLONE)

The DorrClone is a compact cylindro-conical classification unit utilizing centrifugal force in place of gravity. It provides a new method of separating finely divided solids in liquid suspensions and constitutes an important new tool with which to supplement current established practices.

RESEARCH AND DEVELOPMENT

Development of the DorrClone (DSM Cyclone) was begun in 1939 by the Dutch State Mines in The Netherlands, where a continuing research and development program has been carried on since that time. The Dorr Company, as exclusive licensee under the Dutch State Mines patent rights in all fields other than that of heavy media separation, has been actively engaged since 1948 in development work relating to design variables affecting performance, materials of construction and possible fields of commercial use. The result of this program is a carefully engineered unit, capable of controlled and predictable operation.

PRESENT AVAILABILITY

DorrClones are now available singly or in multiple arrangements in four standard sizes: 3", 6", 12" and 24" diameters.

APPLICATIONS

Standard units are now limited to separations in the 20 micron to 100 mesh range but present studies indicate broader applications in the future. Typical commercial applications proven to date are:

Degritting of viscous suspensions such as milk of lime and clay slurries.

Desliming of metallurgical pulps, phosphate rock, coal, iron ore and tailings for mine backfill, with the production of extremely dense underflows where such are desired.

Classification of crystalline and other granular suspensions.

PATENTS

The DorrClone is covered by patents issued and pending in the United States and other countries.

Further information... We welcome inquiries on specific problems and applications and are prepared to undertake engineering investigations within the scope of our present knowledge and experience.

*DorrClone is a Trademark of The Dorr Company

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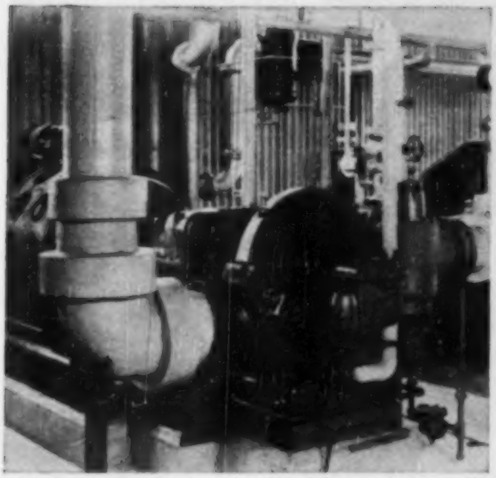
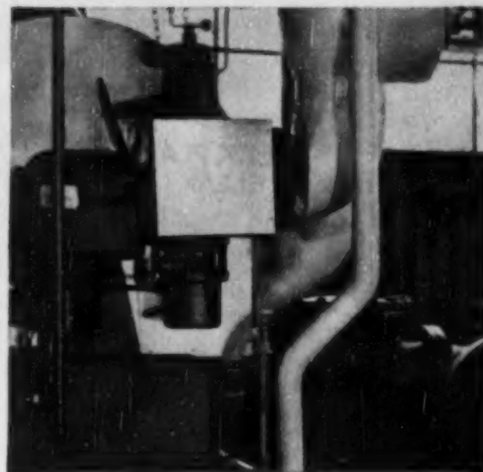
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH ▬ ENGINEERING ▬ EQUIPMENT

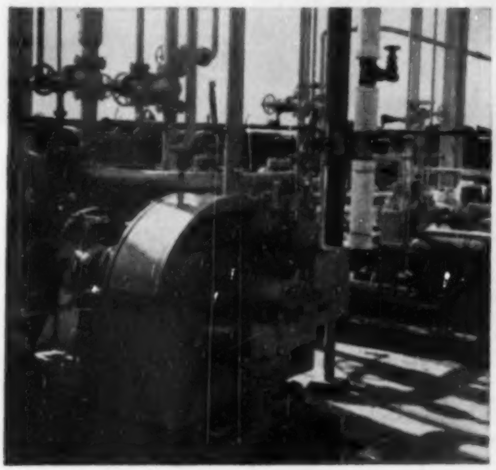


Here a 100 kw generator is driven through a gear coupling by a standard DP turbine. This kind of assignment requires accuracy and reliability such as you would expect only from much more expensive turbines.

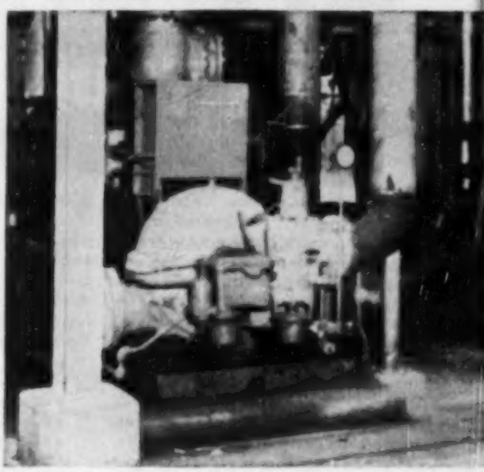


The DP turbine's totally enclosed governing system is always ready for immediate service—even after long periods of idleness. In this West Coast sawmill, DP's are used to drive standby fire pumps.

BOOST YOUR PRODUCTION



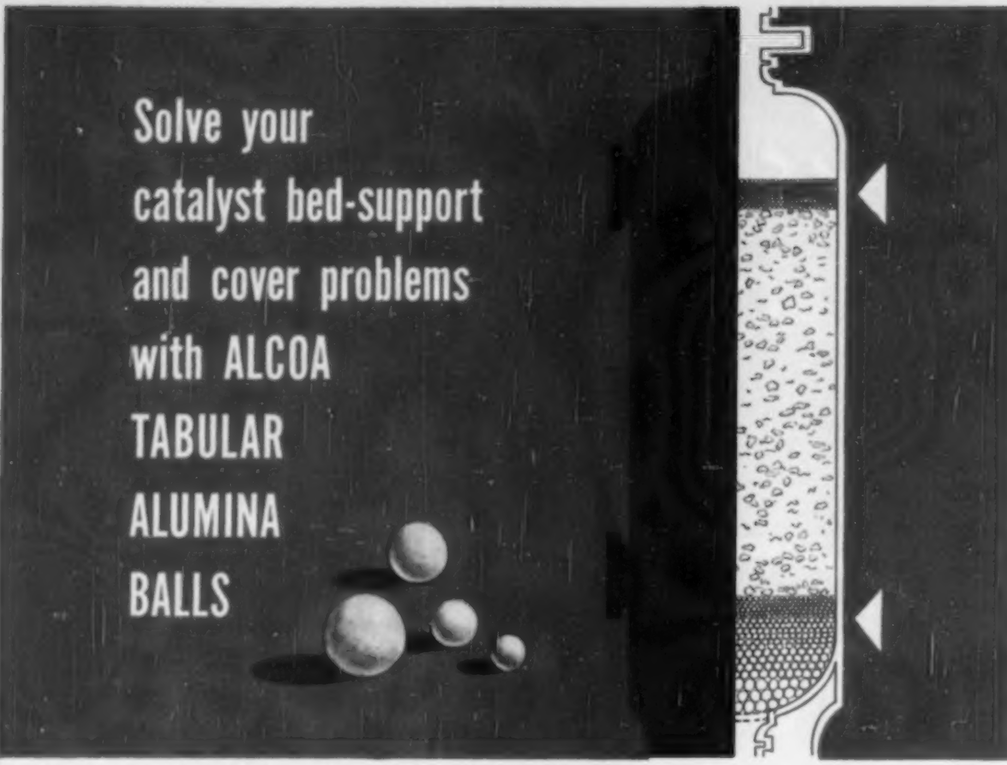
You can install the DP anywhere—indoors or outdoors—without fear of parts corrosion. This standard DP is driving centrifugal pumps in an outdoor refinery installation.



In this refinery, DP turbines drive pumps used in the catalytic cracking process. Since installation, the turbines have provided dependable service—essential for important, continuous processes.

DP stands for Dependable Power

GENERAL ELECTRIC



These hard ceramic balls may make a lot of difference in the operation of your reactor towers. They provide:

Higher Efficiency . . . Better Operation . . .

—The stream is evenly diffused across the catalyst bed . . . Resistance to stream flow is reduced.

—Ceramic balls replace fine mesh inside screens.

—The cover prevents "dancing" of the catalyst when flow is upward . . . Diffuses the stream when flow is downward . . . Holds catalyst in place, should surges occur.

—High purity (99+% Al_2O_3) . . . High resistance to acids and alkalis . . . Chemically and catalytically inert to most products.

Economy . . .

—Simplifies supporting grid.

—High resistance to abrasion, mechanical shock and thermal shock . . . Can withstand sudden temperature changes of more than 1000° C. (1832° F.).

Adaptability . . .

—Any depth of bed-support and cover can be used . . . Five sizes of balls—from ¼" to ¾"—permit a selection best suited to your process.

In addition to their uses as bed-supports and covers, ALCOA Tabular Alumina Balls also offer you money-saving advantages when used as a heat-exchange medium. They have both high heat capacity and high heat conductivity.

Specific heat (at 1000°C.)=0.3 cal./g./°C.
k (at 800°C.)=
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ALCOA Tabular Alumina Balls may help solve a difficult problem. Let us tell you more about this unique form of alumina. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 602M Gulf Building, Pittsburgh 19, Pennsylvania.

Alcoa Chemicals

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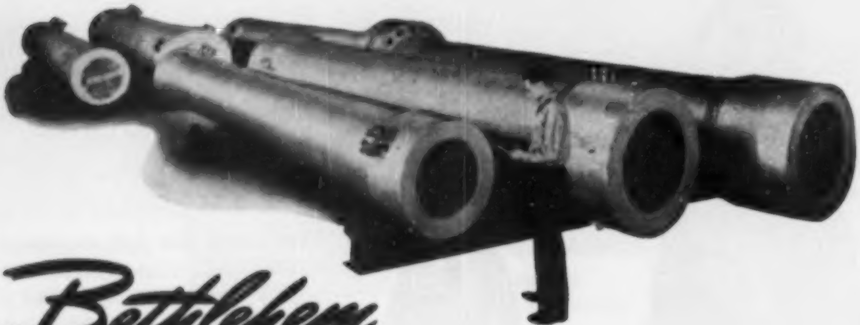


No. 47 Boiler Water Feeder — for hand-fired steam heating boilers up to 5000 sq. ft.
No. 47-2 Feeder - Cut - off Combination for automatically fired steam heating boilers up to 5000 sq. ft.
No. 147 Boiler Water Feeder — Similar to No. 47, but with higher feeding level for process steam boilers.
No. 247 — Same as No. 47, but for installation with 1" equalizing pipes.
No. 53-2 Feeder Cut-off Combination — Similar to No. 51-2, but built for higher pressure, up to 75 lbs.
No. 51 Boiler Water Feeder — for hand fired steam heating boilers over 5000 sq. ft.
No. 51-2 Feeder - Cut - off Combination — for automatically fired steam heating boilers over 5000 sq. ft.
No. 67 Low Water Fuel Cut-off — for low pressure steam boilers of any size.
No. 150 High Pressure Pump Control, Cut-off and Alarm — for steam boilers of any size up to 150 lbs. pressure.
No. 157 Water Column Type High Pressure Pump Control, Cut-off and Alarm — for steam boilers of any size up to 150 lbs. pressure.
You should know ALL of these
McDONNELL PRODUCTS
No. 101 Electric Water Feeder — operated by No. 67 or liquid level switches.
• You are probably familiar with the more commonly used McDonnell Products. But for those jobs you may run across from time to time that call for special equipment, you should be familiar with all the McDonnell liquid level controls, flow switches, and similar products listed here. They are all evidence of how intensively McDonnell has worked at "DOING ONE THING WELL." We will be glad to give you information and counsel on any special application that may arise.
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Doing One Thing Well
No. 33 Safety Relief Valve — for hot water heating boilers. Bls. rated. ASME standard.
No. E-2 Flow Switch — Completes (or breaks) circuit when flow starts or stops.
No. 21
No. 121
No. 321
No. 421
Make-up Water Feeders—to maintain adequate water supply in receiving tanks. Nos. 21, 121 and 321 are installed right in tank openings; available in various flange forms and sizes as shown to fit existing openings. No. 421 is for external application, with equalizing piping.
No. L-8 Constant Level Valve — Maintains constant fuel oil pressure on burner.
No. 417 Snap Action Water Valve — Maintains water level in humidifier pans and in tanks.
No. 517 Water Level Control — Same as No. 417, but in die cast float chamber with cover.
No. 355 Large Capacity Float Valve — Has many uses on tanks, stills, receivers, etc.
No. 61 Low Water Fuel Cut-Off — for 1" equalizing pipe installation on low pressure steam boilers.
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No. 65 Explosion-proof Electric Controller — Underwriters' approved for hazardous locations.
No. 69 "Built-in" Low Water Cut-off — Typical of many "built-ins" for installation in tappings provided in modern boilers.
No. 469 "Built-in" Low Water Cut-off— Similar to No. 69, but with less projection into boiler.
No. 767 Low Water Fuel Cut-off — (with No. 14 blow-off) for easy installation into opening to boiler.
No. 80 Switch — Three wire high- or low-level alarm or pump control on oil storage tanks.
No. 6667 Conversion Head — for converting former cut-offs into two-switch types.
No. 154 High Pressure Pump Control — Similar to No. 150, but with open contact switches.

Who Buys VU-10 Boilers?

A quick answer is that VU-10 purchasers include industrials ranging from very small to the largest, as well as schools, hospitals, institutions, and, in fact, every type of establishment that requires boilers in the VU-10 capacity range. Why, then, limit the list of representative users on the opposite page to names known to everyone as among the biggest industrial enterprises in the country? Because such names form a significant guide for a prospective boiler buyer, in the same sense that the buying decisions made by operators of large truck fleets can be a reliable guide for the man who wants to buy a single truck.

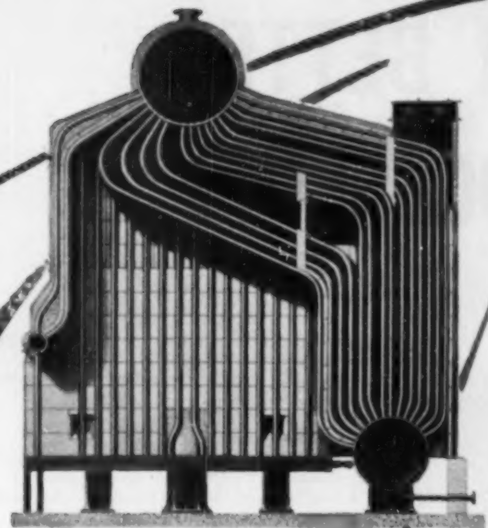
This reasoning applies *especially* to the purchase of a boiler. Big companies buy boilers frequently . . . therefore their experience is always up to date. They buy them for plants in many locations, using many different fuels. They buy them in capacities from very small to very large. Their requirements justify the employment of highly qualified engineering specialists—both staff men and outside consultants. Thus they have the breadth of experience and the expert guidance requisite to making the soundest equipment selections.

And perhaps equally important, big companies tend to place more emphasis on long-term operating and economic results. They know from their own experience that daily operating economies accruing through the years from better design and construction features will quickly offset the difference in first cost between the cheapest boiler they can buy and the best the market affords.

So if your steam requirements call for boilers in the capacity range from 10,000 to 60,000 lb of steam per hr, we submit the acompanying representative list of large companies that have purchased VU-10 Boilers as a sound reason for confidence that your decision to buy a VU-10 will prove to be a highly profitable one—not only for the first few years of service but throughout the lifetime of the installation. B-439

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



C-E Vertical-Unit Boiler

Type VU-10

The VU-10 Boiler is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 60,000 lb per hr. Firing may be by spreader, underfeed, chain or traveling grate stokers, or by oil or gas burners. Superheater, economizer or air heater surface may be added if desired.

Representative large companies that have purchased VU-10 BOILERS

Air Reduction Company
American Locomotive Co.
Armour & Company
Borg Warner Corporation
Thomas A. Edison, Inc.
Ford Motor Company
Robert Gair Company
General Foods Corporation
B. F. Goodrich Chemical Co.
Illinois Packing Company
Johns-Manville Products Corp.
Jones & Laughlin Steel Co.
Liebmann Breweries, Inc.
Liquid Carbonic Company
National Distillers Chemical Co.
New York Central R.R.
Owens-Illinois Glass Co.
The Pennsylvania Railroad
Remington Arms Company
Revere Copper & Brass Co.
R. J. Reynolds Tobacco Co.
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C-E

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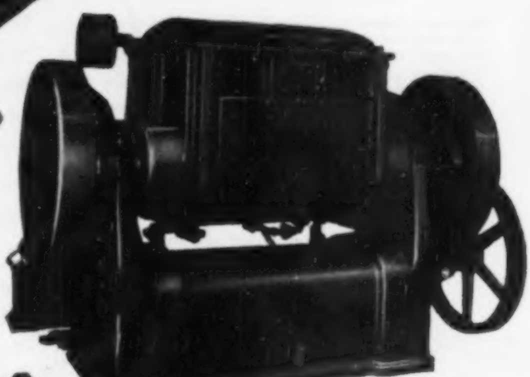
TYPE HS-36 BAKER PERKINS "ter meer" UNIVERSAL CENTRIFUGAL for filtering solid-liquid slurries.

- Capacity — 4500 lbs. per hr. (Dependent on material)
- Drum speed 1000 x G.
- Drum diameter — 36 inches
- 20 HP Single Motor Drive
- Construction as desired . . . alloy, rubber lined or iron and steel. Either fume or vapor tight.
- Fully automatic with cycle controller that handles every centrifugation cycle.

SIZE 16 JYEM2 UNIVERSAL MIXING AND KNEADING MACHINE for wide variety of chemical processing operations.

- Capacity 150 gallon working, 225 gal. total
- Sigma-type blades of cast steel
- 50 HP single motor drive
- Trough of fabricated steel jacketed for 80 lb. steam pressure.
- Vaulted, hinged and counterbalanced vapor-tight cover with quick opening clamp



SIZE S-15 BAKER PERKINS "ter meer" CONTINUOUS CENTRIFUGAL for centrifugation of free draining crystalline, granular and fibrous materials of all types.

- Capacity — 6000 lbs. per hr. (Dependent on material)
- Drum speed — 450 X G Constant speed
- 20 HP single motor drive
- Drum diameter 15 inches
- Operates with continuous feed and discharge
- Lower Power input.

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SIDNEY D. KIRKPATRICK, Editorial Director JOHN R. CALLAHAM, Editor

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

DECEMBER 1950

Strength at the Grassroots

Add Cleveland to the list of progressive communities that are building stronger professional spirit and unity among their technical men. Cleveland Technical Societies has set a fine record in bringing about closer cooperation among the local sections of many diverse engineering and scientific societies. During the war the chemical profession of Cleveland led in sponsoring corrosion and other joint symposiums of broad interest to local industries. In November 1949, and again last month the same group proved they could forget their divisions and subdivisions as chemists, electrochemists and chemical engineers to pool their efforts toward professional progress.

This is altogether fortunate and timely because Cleveland is fast becoming one of the country's important chemical centers. Within the past five years, 90 concerns have spent $700 million in this immediate area. Much of this has been for the production of chemicals and allied products that have only recently emerged from research laboratories. More is coming as the defense program gains momentum. There is increasing opportunity for the chemical profession to help in guiding this progress. It can do much to promote a better understanding of what the chemical industries can and are contributing to the community. In short, here is an opportunity and challenge for unselfish service to the public good—a prime responsibility of any profession.

Believing as strongly as we do that the true strength of the chemical profession lies in its local activities, we were shocked to learn that opposition to these technical councils has been developing in some of our national organizations. In July we read of an ancient ruling of the governing body of the American Chemical Society urging its local sections to refrain from joining such bodies—primarily because of fear that some political activity on the part of these local councils might endanger the national charter and therefore the tax-free status of the society. The matter was referred to a competent committee, under the chairmanship of Foster Dee Snell.

After studying the constitutions and by-laws of 35 different councils, the committee recommended and the ACS council at Chicago approved a new by-law which makes it mandatory for all local sections to obtain council approval before affiliation with any state or local organizations. In the words of Chairman Snell "there is dynamite" in this situation. Any arbitrary action that will limit the rights of the chemical profession to contribute its specialized knowledge and experience to the problems of the community is certainly not in the public interest. Who is to say that chemists as citizens should not join with other technical men, as they have in Syracuse, Detroit, and Dayton—in taking a political stand on civic issues.

From what we have recently observed in Cleveland, the chemical profession there is ready and willing to do its part in community affairs. Senator Taft's smashing victory in the last election seems to have taught at least one important lesson, namely, that the rank and file members of organized labor did not always accept the dictation of their so-called labor leaders in Pittsburgh, Washington and Detroit. Instead they and their families voted their true convictions, as all free citizens should.

There is not necessarily any parallel between organized labor and our technical and scientific societies. But the officers and salaried employees of each must reckon with the fact that their support—as well as the strength of the profession—stems from these same grassroots. They should be firmly planted in what the late President William E. Wickenden of Case called "unrequited service to the common good." They should "seek to invest their work with a wide and enduring significance." For it is only in this way "that a calling may attain to the dignity and distinction of a profession."

Sidney D. Kirkpatrick

VINYL RESINS

HOW VINYL CHLORIDE IS MADE ➡

Naugatuck Chemical makes its Marvinol polyvinyl chloride resins in one of the largest and most modern units of its kind.

CLAYTON F. RUEBENSAAL

Naugatuck Chemical makes its vinyl chloride monomer by the vapor phase reaction of hydrogen chloride and acetylene (see flowsheet on opposite page). This is the process most generally used in this country. Naugatuck picked it for two reasons: (1) it gives a high-purity product, (2) it provides a plant located near the large northern and northeastern markets. The plant's proximity to these markets permits the vapor phase process costs to compare favorably with the pyrolytic cracking of ethylene dichloride. Cost advantage of the pyrolytic process is diminished somewhat when freight costs are taken into account to get the monomer or the finished polyvinyl chloride product from the Southwest to the northeastern markets.

Hydrogen chloride gas for Naugatuck's Painesville plant is piped from the adjoining plant of Diamond Alkali Co. Great care is taken to keep HCl gas dry because otherwise (1) more corrosive conditions are experienced, (2) acetaldehyde is formed as a byproduct in the reactors.

Acetylene gas, one of the raw materials, is kept at or below a dew point of −40 deg. F. The water content of the other raw material, HCl gas, is kept below 0.02 percent by weight. Several of the reasons for the exceptional purity of Naugatuck's monomer are the three-stage scrubbing operation on the acetylene and the high purity of Diamond's HCl made by the newly developed absorption-desorption process. After the HCl is dissolved in water, leaving inerts behind, it is further purified when it is driven off as a pure wet gas. It is dried in refrigerated condensers rather than in the conventional sulphuric acid scrubbing towers.

Dry HCl at about 12 psig. is mixed with dry acetylene gas in a vapor blender in approximately molal equivalents. A slight excess of HCl is used; it is the cheaper of the two reactants and permits the acetylene to react more completely. Orifice and rotameter control have been used for this proportioning control step.

The gas mixture is fed into the top of 14-ft. multitube reactors. These carry many small vertical iron tubes and are hooked up in banks of nine for parallel flow of the gases. The reactors are packed on the tube side with activated carbon pellets impregnated with catalyst.

Warmup of the catalyst mass to start the reaction is done by circulating Dowtherm on the shell side of the reactor. The addition reaction is highly exothermic, requiring the Dowtherm to be used as a coolant after the reaction is under way.

Temperature of the reaction may vary between 280-400 deg. F., depending on the age of the catalyst. Higher temperatures are used toward the end of the catalyst's life. Yield is over 90 percent.

Product of the reaction is vinyl chloride; byproducts are ethylidene dichloride and aldehydes. Exit gases from the reactors also contain small amounts of unreacted hydrogen chloride and acetylene.

This reaction mixture, called crude vinyl chloride, is cooled in conventional heat exchangers. The small proportion of uncombined reactants are stripped out in a combination stripping and fractionating operation. The crude monomer may be stored in tanks once the HCl is removed. In this form it is called stabilized monomer.

Another refrigerated fractionating column tops off the pure vinyl chloride. The high boilers, including ethylidene dichloride and aldehydes, are left behind in the reboiler. Refrigeration used on the fractionating column condensers is supplied by three two-stage ammonia compressors. A small residue receiver and pot still is set up for recovering the small amount of ethylidene dichloride from the still bottoms. Scrubbing towers are also used in the purification system to rid the monomer of trace impurities.

Extreme care on temperature and pressure control, feed and take-off rates on the fractionating columns and rigid quality control is used to insure an extremely high-purity monomer. This, in turn, gives high stability and purity to Naugatuck's Marvinol VR-10 and VR-20 polymers.

Storage tanks for pure monomer are of stainless steel; those for stabilized, inhibited and recycle monomer are steel. Tanks are provided with cold weather heaters and water decanters. Maximum single tank capacity used is 25,000 gal.

PLANT—Marvinol resins plant of Naugatuck Chemical division, U. S. Rubber Co., Painesville, Ohio.

BUILT—By Glenn L. Martin Co.'s chemical division. First unit began production in August 1947. Constructed by Chemicals Division of Blaw-Knox. Purchased by Naugatuck Chemical in December 1949.

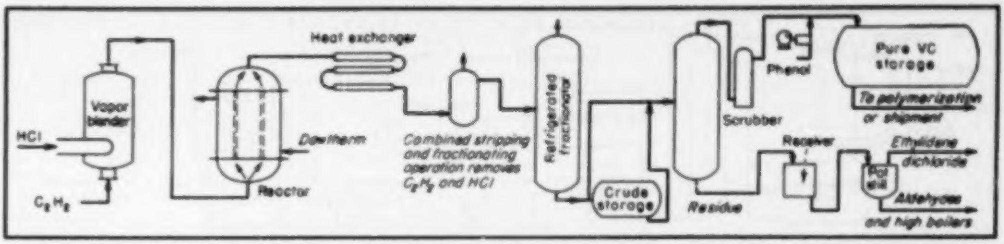
SIZE—Third largest and most modern of its kind. Initial construction cost more than $6,000,000. Plant personnel numbers about 200. Designed to produce 25,000,000 lb. a year of Marvinol resins.

PRODUCTS — Vinyl chloride monomer, polyvinyl chloride resins (Marvinol VR-10 and VR-20).

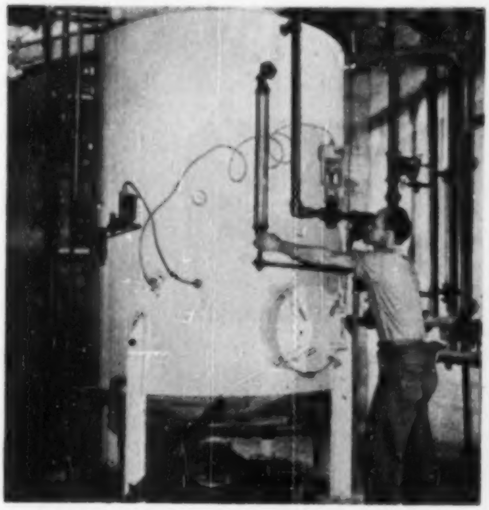
RAW MATERIALS—Hydrogen chloride gas from Diamond Alkali Co.; calcium carbide (for acetylene) from National Carbide Co., Ashtabula.

PROCESS—Vapor phase reaction of hydrogen chloride and acetylene to form vinyl chloride monomer; polymerization of monomer to polyvinyl chloride resin.

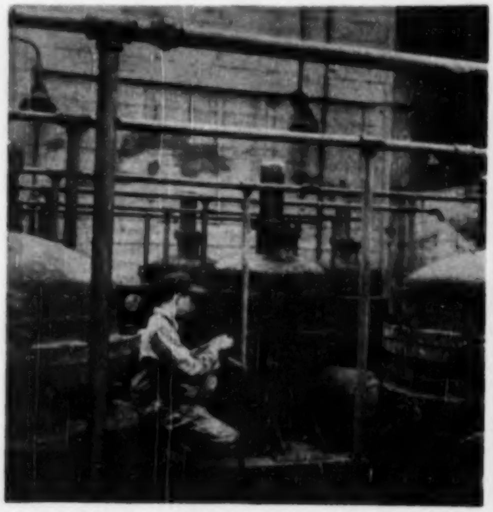
CLAYTON RUEBENSAAL is one of the *reasons why the Marvinol plant at Painesville is one of the best engineered units of its kind anywhere. Three months ago United States Rubber Co. transferred him to Naugatuck, Conn., and made him technical director of plastics and resins for its Naugatuck Chemical division.*



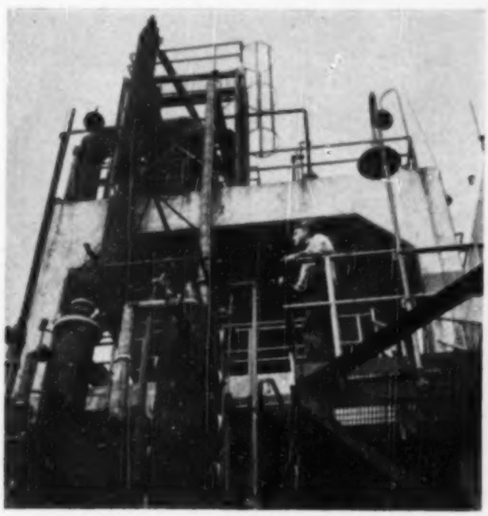
MONOMER vinyl chloride is made as diagrammed and illustrated on this page. See next page for the polymerization picture.



ACETYLENE generator operates under controlled temperatures and pressures. Reaction is water on calcium carbide.

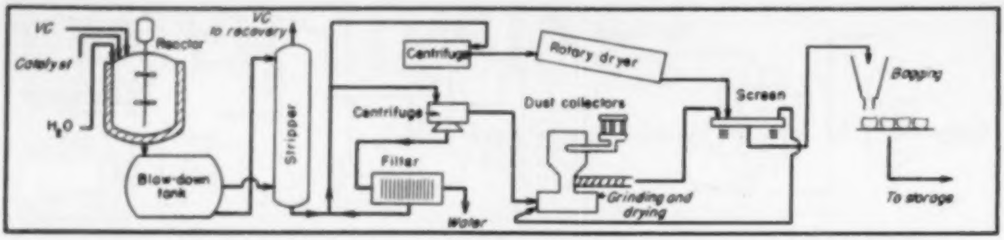


REACTORS combine purified acetylene and hydrogen chloride with a catalyst forming vinyl chloride, limited byproducts.

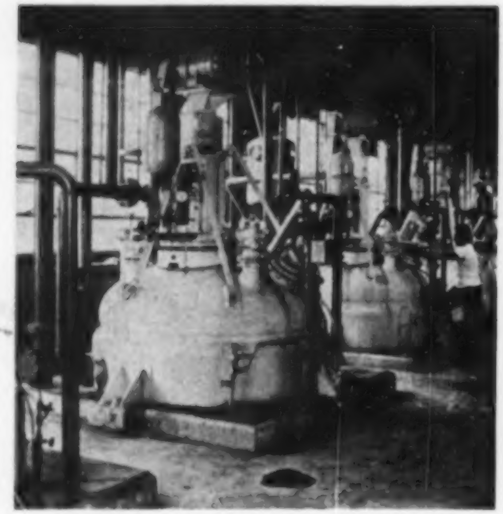


PURIFICATION of vinyl chloride in distillation columns. Unwanted gases and byproducts removed before polymerization.

CONTROL almost entirely by automatic equipment, is keynote of Marvinol's modern plant. Panel installation shown above.



POLYMER for Marvinol resins is produced as shown here. The pictures below illustrate processing and handling operations.



POLYMERIZERS handle buildup to macromolecules. Catalytic reaction of vinyl chloride and water is carefully controlled.

CENTRIFUGE handles slurry of water and white powder discharged from polymerizer. Powder later ground to fine size.

CYCLONE separators handle material after it is centrifuged and dried. Their function is recovering powder from air.

STORAGE of the resins is facilitated by modern methods of "good housekeeping." Pallets and lift trucks ease handling.

⬅HOW VINYL CHLORIDE IS POLYMERIZED

Naugatuck uses two major operations in making its vinyl chloride resins: (1) catalytic polymerization of the vinyl chloride monomer; (2) finishing operations that involve dewatering, drying, grinding and screening of the resin products (see flowsheet on opposite page).

Reciprocating and centrifugal pumps of 50 gpm. capacity have both been used to deliver pure monomer from the tank farm to proportioning meters feeding the reactor.

High-purity water must be used in the polymerization reaction. The water fed to the ion-exchange units is softened by treatment with lime and alum. It is then pumped through a pressure filter packed with a powdered coal bed, then to the catexer and anexer of two ion exchange units. Treated water is stored in an aluminum surge tank. Before being metered to the polymerizers, it is sent through a decarbonator where carbon dioxide and oxygen are removed. Treated water is pumped to the charge meter by a 135-psig. centrifugal pump. It is warmed to reaction temperature in steam heat exchangers before being charged to the polymerizers.

Separate charge pots are used for mixing and proportioning the polymerization additives such as catalysts and viscosity control agents. Catalysts reported in the literature as being used in the polymerization of polyvinyl chloride include inorganic water soluble persulfates or hydrogen peroxide, and organic monomer soluble catalysts such as benzoyl, acetyl, dicaprylyl, and stearoyl peroxides. Wetting and suspending agents control particle size.

After the monomer and water have been metered into the glass-lined polymerizers, the mixture is agitated and brought to polymerization temperature. This may be between 110-130 deg. F. depending upon the particular formulation being run. Catalysts and control agents are then flushed in. In general, the higher the temperature the lower the viscosity of the polymers. The polymerization is exothermic and requires temperature control of ±0.5 deg. F. to maintain uniform high quality.

Each reactor is equipped with Duraseals on the agitator shafts. Reflux condensers are used for additional temperature control. Self-cleaning, water-flushed, bottom dump valves are manually operated to discharge the polymerization batch to 10,000-gal. glass-lined blowdown tanks. Here the residual monomer is stripped out and recirculated as recycle monomer to the tank farm.

Upon completion of a run, some unreacted monomer still exists in solution in the water and absorbed on the polymer. This must be removed from the polymer particles by high temperature and low pressures. The stripping operation is used both for economy of raw materials and purity of the finished product. Recovered monomer (called recycle monomer) is compressed in 400-mm. suction, 90-psig. discharge compressors. This monomer is dewatered and stored in the tank farm. It must later be sent through the purification system before it is again used for polymerization.

Not only high quality but consistent quality is demanded by vinyl resin users to prevent variation in the specifications of their compounded stocks and continued adjustments in their process operations. To provide consistent quality resins the Painesville plant was designed to permit liquid blending and subsequent dry blending of the finished resin.

By following the polymerization to this point it will be seen that the manufacture of the acetylene raw material and the vinyl chloride monomer are both continuous operations. Polymerization of the monomer to polyvinyl chloride is a batch operation. From this point on the polymer is handled on continuous and batch type equipment.

After the polymer-water suspension has been stripped of residual unreacted monomer, it is pumped to the finishing unit where it is dewatered and dried.

As the polymer suspension reaches the finishing building it is pumped to the third floor where it enters surge tanks used to feed the centrifuges. Both bottom discharge basket-type batch centrifuges and continuous discharge centrifuges are used. The polymer is dewatered, washed and dewatered again to about 20-25 percent moisture.

Dewatered polymer cake is dumped by gravity flow to two types of dryers. One is a continuous feed flash type in which the material is ground, dried and air classified in one operation. Oversize material is recycled to the grinding chamber until it reaches the proper size to leave through the air classification system.

Vibrating bag type dust collectors are used to remove resin dust from the air stream before it is discharged to the atmosphere.

It was found early in the startup of the plant that the conventional oil filter for cleaning air used in drying the resin was not efficient enough for best quality. Trace amounts of colloidal contamination were being carried through and deposited on the resin. This slight contamination was found to make the resin less stable at the high temperature used in processing. It was found that electronic precipitation removed these last trace impurities to give a completely dust-free air stream. A large unit was therefore installed to handle the complete air stream used in drying. Although the further improvement effected by this measure on the heat stability of the resin was slight, it is another example of how no expense was spared to produce the ultimate in a heat and light stable polyvinyl chloride resin.

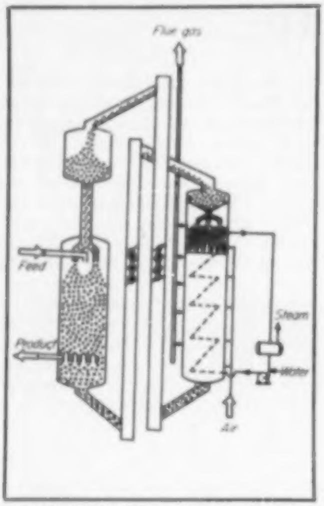
The other dryer is a continuous rotary type in which hot air passes countercurrent to the resin flow. Both dryers use air temperatures of about 140-150 deg. F.

Magnetic separators are used on the conveyor lines carrying both the wet and dry polymer to pick up any tramp iron that might have gotten into the resin stream. At certain points in the plant Syntron vibrators are affixed to the discharge and feed hoppers to prevent packing of the polymer.

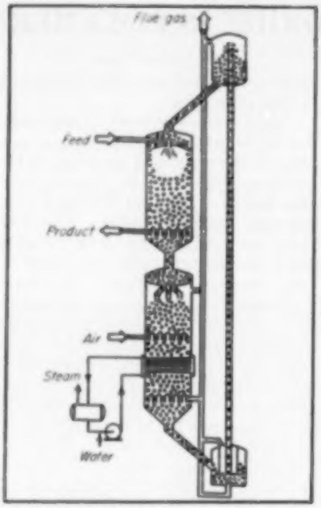
Dried resin is further dry blended in 1,000-cu. ft. vinyl-lined storage bins. Screw conveyors and bucket elevators carry the resin from the bottom of these storage bins back up to the third floor.

Blended resin flows by gravity through screening devices and then into a pre-weigh hopper. This weighs it into 50-lb. lots ready for the bagging machine. Multiwall five-ply white wrinkle finish Kraft bags are used for packaging Marvinol resin. The wrinkle finish was designed to make the bags easier to handle by the customers' factory men. These bags, after being check weighed, are sewn on an automatic stitcher.

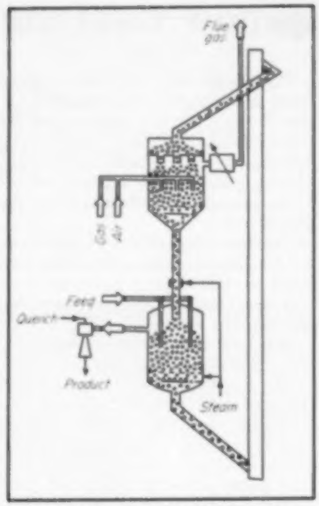
Vinyl resins are used for making crystal-clear film, tubing and sheeting as well as white and pastel shades; hence extreme cleanliness is required at all times during the manufacture of the resin and later in the processors' plants. Many modern vinyl fabricating plants are air conditioned and painted in light colors. To fit in with this scheme of cleanliness Naugatuck designed the white bags that are now used to package the high-purity Marvinol resins.



1 THERMOFOR process, developed about eleven years ago, is improved.



2 HOUDRIFLOW is two years old, eliminates elevator, uses a gas-lift.



3 PYROLYTIC CRACKING heats gas above metallic heat exchanger range.

Evolution of a Process

Moving-bed process has made big strides in recent years. Perhaps your plant can benefit through use of this technique

MARSHALL SITTIG

We have come to regard progress in the chemical industry as the expected thing. We often fail to appreciate the efforts of our fellow engineers by failing to sit down and consider the broad strides made by some specific process over a period of a few years. Let us consider the moving-bed process for the catalytic cracking of hydrocarbons, the Thermofor process, for a few minutes—to see what principles can be applied to our own operations.

The evolution of any idea from inception through subsequent refinements to various finished applications is always interesting. All too rarely do we get a glimpse of the development of a chemical process from its initial trial to a final full-scale operation in a variety of forms. Studying the evolution of such a process cannot help but be stimulating to the process engineer.

In the percolation filtration of lubricating oils, which is a step designed to improve color, odor, stability and demulsifying properties of oils, the fullers earth or activated bauxite adsorbents become contaminated as the filtration proceeds. To permit re-use of the percolation clay in ten or twenty more filtration cycles, the clay is withdrawn from the percolation filters and burned at temperatures up to 1,100 deg. F. to regenerate it. One device used in the regeneration step (multiple-hearth burners similar to those used in the roasting of ores have also been used) was the Thermofor kiln. The Thermofor (from the Greek "thermophore," a device for controlling heat) kiln was developed by the research and development division of the Socony-Vacuum Oil Co. The first installation of a Thermofor kiln in clay-burning service was made early in 1939. Thus, the period of process evolution covered in this article begins just a bit more than ten years ago.

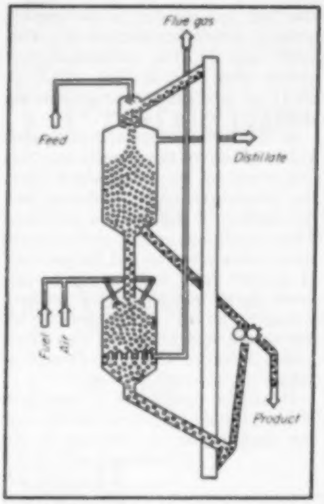
MARSHALL SITTIG is a chemical engineer who has followed industrial developments for many years. In this article he presents some interesting thoughts on the broader application of existing moving-bed processes to solids-handling problems.

THERMOFOR PROCESS

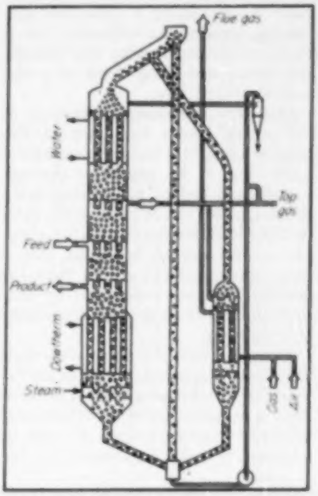
The Thermofor kiln was simply a vertical vessel containing a bundle of spiral-finned tubes. These tubes were so designed as to permit air to pass upward in passages under the spiral fins while clay moved down, over, and around the fins. Molten salt or steam was circulated through the tubes and the fins conducted the heat of combustion to the body of the tubes where it was removed by the circulating salt or steam. Thus, flue gas left the top of the kiln and hot, revivified clay passed out the bottom continuously.

Even though these percolation clays are usually 20-60 or 30-60 mesh, much finer than the usual catalyst pellets, there was here a piece of equipment which, without stretching the imagination too much, could be used to burn the coke deposit from a pelletized catalyst of the type used in the Houdry static-bed process for catalytic cracking. If one can conceive of transporting hot, regenerated pellets to the top of the reactor and continuously removing coke-covered pellets from the bottom of the reactor and transporting them to the top of a Thermofor kiln, one has a continuous process. From such a succession of thoughts was born the Thermofor Catalytic Cracking Process.

The Thermofor process is shown schematically in Fig. 1. The charge stock is preheated in a direct-fired tubular heater, then introduced to the reactor where the oil vapors contact the fresh catalyst pellets. The catalyst pellets enter the top of the reactor through a feed leg, known as the clay



4 COKING makes coke pellets serve as fluid bed while they grow in size.



5 HYPERSORPTION separates gases by adsorption on activated carbon.

leg, which may be as much as 70 ft. high. Spent catalyst leaving the reactor is depressurized, purged with steam, and introduced to the base of an elevator which carries it to the top of the Thermofor kiln. Regenerated catalyst from the base of the kiln enters the elevator also and is deposited in the clay hopper which feeds the reactor by way of the clay leg.

The reactor operates at 10-15 psig. and at temperatures of 850-900 deg. F. The catalyst-to-oil ratio may vary from 1:1 to 8:1 depending on design conditions and on the products required.

The reactor is steel. It is unlined, and externally insulated. The oil feed grid, the inert gas seal at the top, the steam purge seal at the bottom, and perforated catalyst flow plates completed the assembly of earlier Thermofor reactors. Later designs eliminated catalyst flow plates and utilized a so-called "solid-bed" reactor.

The catalyst elevators employed are of the bucket type with chain drive. The bottom sprocket is mounted on a walking beam to overcome uneven operation. It is easy to see that difficult mechanical and lubrication problems could be encountered in a 200-ft. elevator carrying 100 tons of catalyst per hour (in a 10,000 bbl. per day unit) at a chain speed of 100 ft. per min. The regenerated catalyst enters the elevator at temperatures approaching 1,000 deg. F. and coke-laden catalyst from the reactor at temperatures only a little lower.

In later Thermofor units, separate elevators for spent and fresh catalyst have been replaced by a single split-bucket elevator. In this later design, each bucket is divided into three compartments, the combined volume of the two outer compartments being equal to the volume of the center compartment. The center compartment now carries the hotter regenerated catalyst, and the out compartments the spent catalyst. Thus, the chain is protected from the higher temperatures of the regenerated catalyst. In this way, an improved elevator system was evolved; in the succeeding portions of this paper, it will be shown how the elevator disappeared entirely, being replaced by a gas lift.

Since we have a tremendous potential source of heat in the regenerated catalyst pellets issuing from the kiln, the feeding of a liquid charge to the reactor, effecting vaporization upon contact with the catalyst, might seem possible. The effect of thermal shock on the catalyst granules is obviously a factor to be considered here. The replacement of clay pellets with synthetic "beads" was the answer to this and other mechanical handling problems. This new catalyst derived its name from the fact that it was produced in the form of small spherical particles resembling translucent glass beads. An individual bead of ⅛ in. diameter will support a 200 lb. load and a mass of beads in a column will support about 3,000 psi.

A concurrent flow design with liquid or partially-vaporized feed represents practice in the latest Thermofor units. Catalyst is introduced to the reactor through a central feed pipe and over a conical deflector from which it falls in an annular curtain onto the bed. A fog-nozzle inside this curtain serves to inject the liquid feed into the reactor. Such concurrent operation results in maximum utilization of the heat content of both inlet catalyst and inlet oil streams.

A major problem in the handling of moving granular solids in the Thermofor process has been the instrumentation of solids flow. Orifice plates have been used successfully to meter solids flow, the hole in the plate being made tangent to the bottom edge of the sloping pipeline in which flow is being measured. The position of the solids level in a vessel has variously been measured—by putting the entire vessel on scales—by having a series of contacts at various levels on the inner wall of the hopper which respond to solids pressure—by a probe which rides on the solids surface and protrudes from the top of the vessel—and by the use of radioactive salts.

The latest in Thermofor units is a "packaged" unit for the small refiner which employs a unique structural support in the form of a standard oil field derrick. The derrick also serves as a construction rig while the plant is being erected.

HOUDRIFLOW

As mentioned above, the clay leg above the reactor imposes a minimum height limitation on a Thermofor unit. Also, as outlined above, elevator operation offers many problems. These problems were constantly before the engineers concerned with the process, and their solution resulted in the announcement of the Houdriflow process in December 1948. Houdry Process Corp. engineers superposed the reactor on the kiln and substituted a gas lift for the elevators in the new process which is shown in Fig. 2.

Higher ratios of catalyst to oil are possible in the Houdriflow process due to elimination of mechanical limitations previously imposed by the elevator system. Higher catalyst circulation rates give reduced coked deposition per pass, permitting simplified kiln design.

Other process engineers have devoted thought to the problem of transporting the catalyst pellets by other means than elevators. U. S. patent 2,408,600 covers the use of the feed stock in vapor form to carry the catalyst from the base of the regenerator to the top of the reactor. The newest Thermofor units use air to lift the pellets from the base of the regenerator to the top of the reactor.

PYROLYTIC CRACKING

The second variation on the basic Thermofor theme involved the use of

non-catalytic pellets as a heat source for pyrolytic cracking. In this process, pellets are heated to higher temperatures (1,400-1,800 deg. F.) than those encountered in cracking to gasoline (900 deg. F.) by direct combustion of externally added fuel in the kiln bed. The products of such a process are primarily olefinic and acetylene hydrocarbons.

The first published work on the type of apparatus involved in pyrolytic-bed cracking discussed the "pebble heater" which was developed by Babcock & Wilcox Co. as a generalized apparatus for heating gases to temperatures higher than those permissible in metallic heat exchangers where a top temperature of perhaps 1,200 deg. F. is the limit. The pebble heater was designed to double this operating limit and heat gases to 2,400 deg. F.

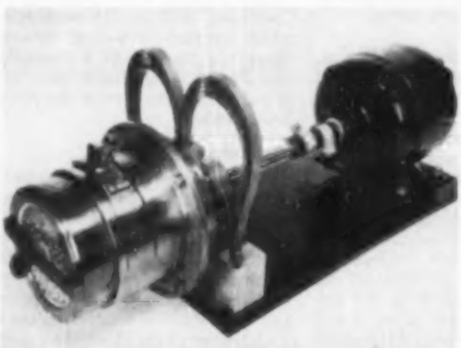
Pebbles for the pebble heater were made by extruding a refractory mix (kaolin, mullite, or alumina) in a plastic condition, forming into spheres, and drying and firing them in a vertical shaft-type kiln.

One very interesting application of the pebble heater has been in the heating of air to temperatures above 3,800 deg. F. by passing it through a preheated bed of magnesium oxide pebbles, giving rise to nitric oxide, NO, by chemical combination of the nitrogen and the oxygen in the air. Nitric oxide concentrations greater than 1.0 percent have been obtained by this method in work done at the University of Wisconsin.

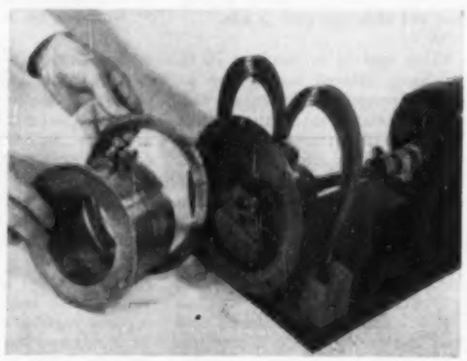
Early in 1948, the Socony-Vacuum Oil Co. announced the Thermofor Pyrolytic Cracking Process. It is essentially a modification of the Thermofor Catalytic Cracking Process wherein, in addition to coke combustion in the kiln bed, fuel gas and air are burned, giving a pebble temperature of 1,400-1,800 deg. F. The pebble-to-hydrocarbon feed ratio is high (10:1 to 20:1) to give the maximum heating effect.

In the manufacture of unsaturated hydrocarbons by this process, reaction conditions are employed which favor the dehydrogenation equilibrium and the fixation of the reaction products. These conditions include short contact times at low pressures and the presence of diluent gases such as steam, followed by a quench of the product stream to prevent rehydrogenation of the unsaturated products. The Thermofor Pyrolytic Cracking Process is shown schematically in Fig. 3.

It will be noted that a waste-heat boiler is installed between the kiln and the stack to permit recovery of the (*Continued on p. 111*)



Bureau of Standards vibratory ball mill uses 3,700 steel balls colliding over 100,000 times per sec.



Construction involves a spring suspension and rotating eccentric weight turning at 1,800 rpm.

Experimental Vibratory Mill Grinds Fibers to Micron Size

Principles used by the National Bureau of Standards in the design of a small laboratory ball mill may prove the basis for improvement in plant-size ball mills. A somewhat similar idea was reported to have been used abroad in commercial sized machines (see *J. Am. Chem. Soc.*, **68**, 2547, 1946) and was commented on favorably by one of the investigation teams that visited Germany after the war.

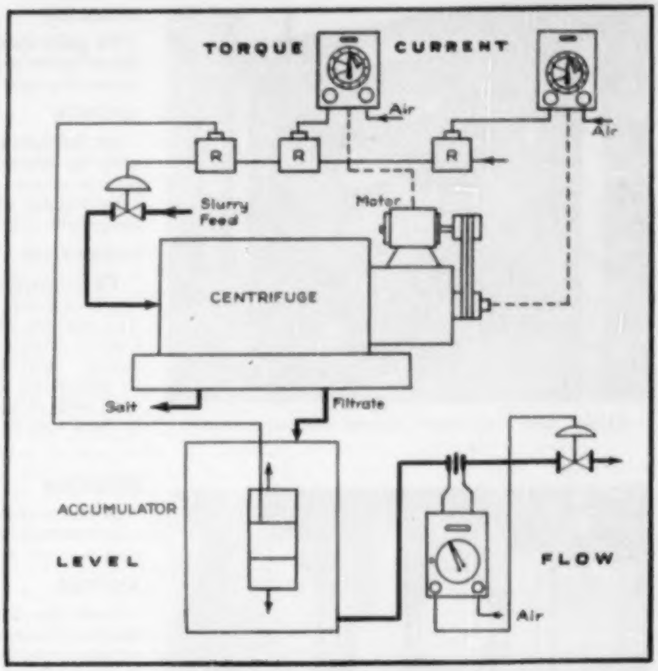
The Bureau of Standards machine, developed by Florence Forziati, W. K. Stone, J. W. Rowen and W. D. Appel, has been applied in reducing cotton fibers to particles of 10 microns or less in major dimensions. This it accomplished in about 30 min., reducing most of the cotton to the amorphous form in that time. Its product was found to be superior to that given by several other fine grinding methods, all of which produced much coarse material.

As the illustrations show, the bureau's machine consists of a cylindrical jar containing steel balls which is supported on a housing containing an eccentric rotating weight. Weight of the housing is carried on springs so that when the ¼-hp. motor rotates the eccentric weight at 1,800 rpm., the housing is swung through a circular path that is confined within limits by the springs. In addition, the jar and its cylindrical holder rotates slowly on a greased slip ring which confines the holder flange against the eccentric housing. This rotation, caused by centrifugal force, takes place at about 4 rpm. in the direction opposite to that of the rotating weight and serves to redistribute continuously the material being ground.

Further details of the mill design are given in *J. Research* NBS, **45**, (1950) RP2116, while working drawings of the mill can be secured by application to the Textiles Section, National Bureau of Standards, Washington 25, D. C.

5 Problems & 5 Answers at Shell Chemical

J. A. PARKER



Three variables—current, torque and level—control salt removal rate, vary with concentration of salt in slurry. Flow of slurry is also controlled.

Shell Chemical's Deer Park, Tex., plant at this writing looms as one of the world's largest for making petrochemicals. With the company turning out more than 1,000 products based on petroleum, its engineers boast that not even the stain has been left.

Some of these petroleum products, exclusive with Shell, presented particular problems with regard to measuring and control. The usual factors of large scale processing were involved: reduction of operating costs, maintenance of uniform high quality products. Since certain of the products were destined for use in medicinals and pharmaceuticals, added care also had to be taken to avoid any possible contamination of product by the instrument elements in the system. As in similar chemical plants, the corrosive and volatile nature of the processed materials, many of which are highly flammable, also added to the difficulties of instrument applications. Solutions to some unusual problems in the plant are outlined in this article.

J. A. Parker *is the senior engineer of the instrument section, Shell Chemical Corp., in Houston.*

PROBLEM

Centrifuges receiving a continuous slurry of salt and glycerine separate one from the other. As salt builds up in the centrifuge bowl, an internal conveyor, operated by a centrifuge drive motor, scrapes it off, discharges it. Torque on the conveyor drive shaft varies as salt concentration in the feed; can be kept at the proper value by regulation of the feed rate.

For a thin slurry, a large volume of liquid has to be accelerated in proportion to the salt removed. Motor horsepower mostly accelerates the liquid with little required for salt removal by the conveyor. Torque measured by the controller could thus be well below the instrument set point. Then the controller would call for more feed, overload the motor, and shut down the centrifuge.

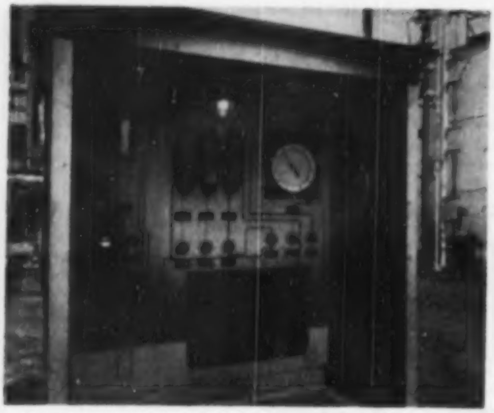
ANSWER

A modified feed control system responsive to current load on the centrifuge motor as well as torque on the conveyor. A third function includes level control of the accumulator tank which receives filtrate. All three of these variables—current, torque and level—are affected by salt concentration in the feed, and are interlocked in a new control arrangement.

OPERATION

Air supply to diaphragm motor valves on the slurry feed lines passes through three pneumatic relays (*R*) which have a 1:1 ratio of air output to control air pressure applied to their pilots. Each relay thus tends to reproduce, as output air pressure, its pilot air pressure, but, connected in series, cannot have an output pressure greater than it receives in the air-to-valve line. Valves are moved toward the closed position to lessen the feed rate with an increase in any one of the three variables.

Until either torque or current reaches the respective set point of its controller, instruments deliver full control of filtrate in the accumulator. This level is, of course, also affected by the rate of filtrate withdrawal from the accumulator, placing this factor under automatic control of flow regulator (see cut). Should torque or current tend to exceed their preset values, their controllers will further decrease the air-to-valve pressure through the action of their respective relays and thereby correct the cause by lowering the feed rate.



Graphic panel with infrared analyzer, Electronik recorder.

PROBLEM

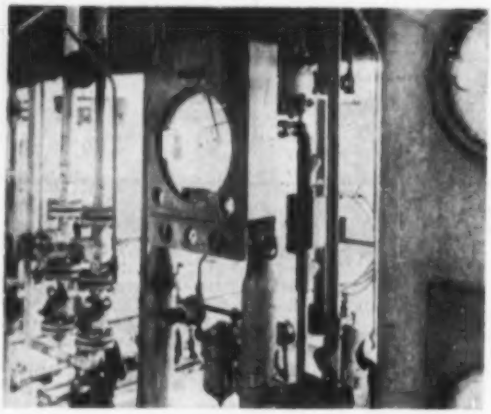
To guide operation of a propylene reactor where it is desired to know how much propylene is left in a residual stream of propane.

ANSWER

An infrared analyzer which measures loss in energy when an infrared beam passes through a sample of the propane stream. Unit is mounted on a graphic type panel board together with an Electronik recorder and associated equipment. (see cut.)

OPERATION

The amsorption of infrared radiation varies with wavelength in a sharply characteristic manner for many gases. The analyzer developed by Shell and Applied Physics Corp. is adjusted to respond to propylene in the propane stream. Shell also uses it on similar problems involving C_1 through C_6 hydrocarbons, both saturated and unsaturated, with as many as four absorbing components present in the sample in important amounts.



Brown dry flow meter measures fluids without mercury contact.

PROBLEM

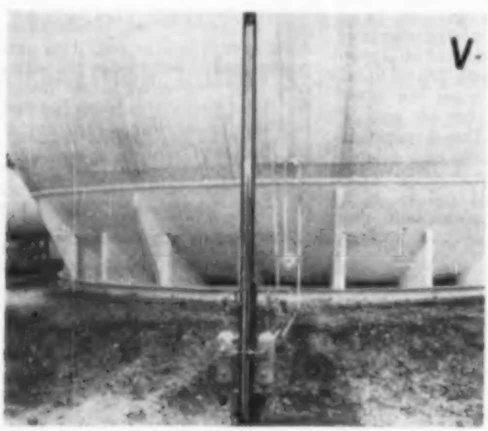
In several chemical processes, conventional flow meters with a mercury U-tube were out, since traces of mercury—even parts per billion—were intolerable.

ANSWER

Credit for this answer goes to the engineers at the Brown Instrument Div. of Minneapolis-Honeywell. A flow recorder-controller with a mercuryless differential pressure unit was found to be completely satisfactory in this application.

OPERATION

Actuating element of the differential pressure unit uses liquid-filled bellows assembly, torque tube, and pressure chamber. Differential pressure created by an orifice in the flow line is impressed across the bellows unit through two connecting lines. Movement of a bellows rod, thus produced, is transmitted to the torque tube which actuates the recorder pen and control unit in the instrument case. Inherent in this design is the total absence of mercury in a unit which is sensitive and accurate for flow measurement.



Purge type, differential manometer for allyl chloride at 10 psi.

PROBLEM

Measuring critical level of corrosive allyl chloride stored under 10 psi. in a Hortonsphere Pressure and toxic nature ruled out an ordinary gaging stick; an a suitable metal for a float and gage tape level indicator was not available.

ANSWER

A 100-in. Merriam differential manometer connected to two dip tubes in the tank.

OPERATION

One tube is in the vapor space near the top of the tank and the other tube passes down through the liquid to the bottom of the tank. The tubes are purged constantly by a small flow of natural gas and back pressure in each tube is connected across the manometer to yield a measure of level. The column of liquid in the manometer is thus balanced against the head of liquid in the tank. Drip pots are installed in the dip tube lines near the manometer, as shown to protect the manometer against possible condensation of allyl chloride vapor from the tank.

PROBLEM

Treating corrosive and harmful impurities in waste water by pH control. Use of an expensive pump in a pH sampling line was obviously undesirable.

ANSWER

A Beckman immersion-type pH cell connected through an electronic amplifier to a recording Electronik pH controller.

OPERATION

The immersion cell is suspended directly in a neutralized waste stream entering settling basins. This cell is equipped with a Saran cage protecting the electrodes from physical damage and a Saran tube protecting the special cable from the cell to a weather-tight terminal box. In accordance with the measured pH, the controller operates a diaphragm motor valve on the chemical treating line to assure properly treated wastes.

EVOLUTION OF A PROCESS

Continued from p. 108

large amount of heat available in the flue gas.

COKING

Depending on refinery production requirements for residual fuel oils, the production of petroleum coke is of varying importance. Coke production is a problem which the refiner must be prepared to meet, however, and conventional coking methods have left much to be desired. Coke was usually formed in a coke chamber where a residual oil was allowed to soak at high temperatures. Removal of coke from such chambers has involved mechanical breaking up of the mass by drills, followed by sluicing out and grinding.

If coke formation in the reactor section of a Thermofor unit could be accelerated and the coke mechanically separated rather than burned off, an improved coking process might result. Sinclair engineers, working along these lines, have been issued U. S. patent 2,494,695 on a process using steel balls in such a coking operation. The coking chamber is operated at 800-1,100 deg. F. and 100-500 psi. The chamber is filled with metal balls which are delivered intermittently to a pressure-release chamber where the sudden release in pressure causes the coke to break away from the balls, whence it is screened out and the balls returned by elevator to a chamber where they are heated by superheated steam prior to readmission to the coking chamber.

A new method, Continuous Contact Coking, eliminates the steel balls of the above process and recirculates a portion of the coke itself as the medium upon which coke is deposited. The Continuous Contact Coking Process was developed jointly by the Lummus Co. and the Gulf Research & Development Co. Its essentials are shown in Fig. 4.

In the coking chamber (the upper chamber in Fig. 4), the heavy oil charge is sprayed onto the circulating coke mass (which exists in the form of rounded lumps from ⅛-in. to ⅜-in. dia.) and gives a varnish-like coating on the particles during the 15 to 40 min. residence in the chamber. The coke particles then drop into a reheater where hot combustion products from a direct-fired air heater meet them. A coke of high mechanical strength, which is dense and quite unlike the usual foamy product which we commonly know as petroleum coke, is thus produced. The dry product from the base of the coke chamber is partially withdrawn and fed to sizing rolls where particles in excess of ⅜-in. dia. are drawn off as product, the finer particles being recirculated.

MOVING-BED ADSORPTION

The products from the pyrolytic-bed cracking operations described above contain ethylene and acetylene as the desired products. Separation of these compounds from unreacted paraffinic gases poses a problem all its own however. The separation may be effected by absorption of the acetylene in some liquid such as a cuprous-salt solution in a gas-liquid scrubber. It may also be effected by adsorption on the surface of a porous material such as activated carbon. Application of the moving-bed technique to the latter process by engineers of the Union Oil Co. of Calif. resulted in the Hypersorption Process.

A diagrammatic representation of a Hypersorption unit is shown in Fig. 5. In this operation, one is faced simply with the problem of reactivating the adsorbent by volatilizing the contaminants, rather than burning off a coke deposit as was the case in Thermofor cracking.

The main Hypersorption column resembles a distillation column with a water-cooling section at the top, a rectifying section in the middle, and a heating or reboiling section at the bottom. Dowtherm is employed as the heating medium at the base of the adsorber and the carbon is stripped with steam below that point. Reactivation of the carbon is carried out by heat exchange of a portion of the circulating carbon stream with combustion gases. Operating conditions in the Hypersorber include an operating pressure of 75 psi. and temperatures varying from 120-140 deg. F. in the adsorption zone near the feed point to 500 deg. F. in the stripping section at the base of the column.

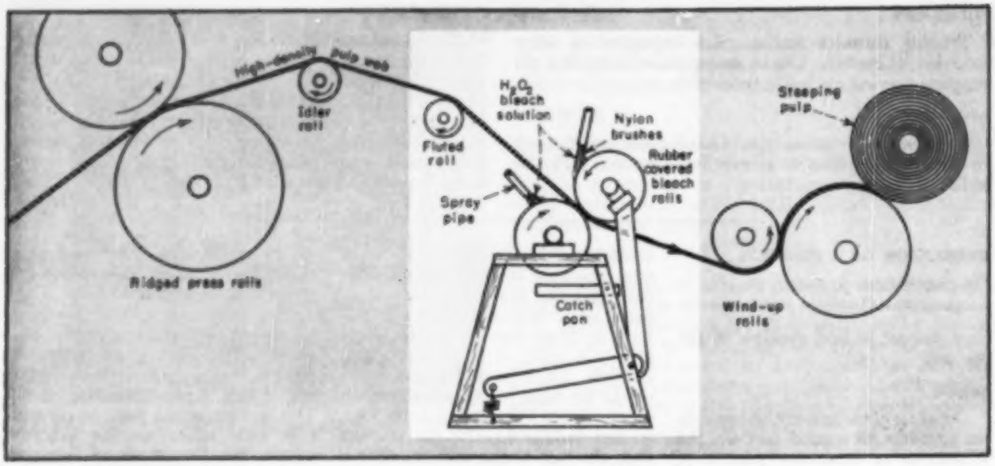
It is interesting to note that consideration has been given to the application of a moving-bed adsorption process to the removal of aromatics and olefins from lubricating stocks. This process would then be competitive with solvent-treating processes such as liquid-liquid extraction.

Another adsorption application using the moving-bed technique is now under development by the Stanford Research Institute and by other groups. This is a continuous ion-exchange process wherein the ion-exchange resin is continuously removed to a separate vessel where regeneration of the resin by an acid or salt solution takes place, regenerated resin being constantly returned to the ion exchanger.

CONCLUSION

Thus, from a kiln for the regeneration of decolorizing clay, we have followed the evolution of five different commercial processes producing a wide variety of products. Tomorrow, next week, or next month, we may see another adaptation of the fundamental moving-bed technique. One recent and ingenious development is credited to the Phillips Petroleum Co. and is covered by U. S. patent 2,490,-975. It represents what might be called an "expendable catalyst process." In this process, a combustible catalyst support of charcoal, coke, or sawdust is fed to a rotating drum and sprayed with a suspension of alumina. The impregnated product is dried in a current of hot air and concurrently fed to the reactor with the oil charge. Catalyst and oil vapors are disengaged at the base of the reactor. Catalyst regeneration may be eliminated or simplified by the use of the combustible catalyst support.

Other applications may be visualized wherein moving pellets are used to transport one reactant into a reactor and when that reacting component is leached from the pellets, the inert pellets might be conveyed to a second vessel for continuous impregnation prior to return to the reactor.



New Pulp Bleaching Technique . . .

. . . offers the small operator a simple way to bleach pulp sheets at high efficiency and low cost—and to get a better product.

Here's a new pulp bleaching technique—a hydrogen peroxide cold steep process—developed by the Buffalo Electro-Chemical Co., aimed at the small operator.

What It Offers. Besides dollar savings, Becco's cold steep process offers these advantages:

BETTER PRODUCT: Physical properties superior to those of pulps bleached by peroxide at moderate temperatures or by chlorine at the same brightness levels. Holds for mullen, tear, tensile and cuprammonium viscosity. Superior properties of special interest in super-bleaching moderate brightness pulps to the 85-90 level.

ADAPTABILITY: Single-stage bleach can be used for groundwood, semi-chemical and sulphite pulp sheets or crumbs. Especially useful for super-bleaching sulphites and krafts to 85-90 brightness. Can be used with most machines—Kamyr, Roger's, feltless wet or modified normal wet.

EQUIPMENT SAVINGS: No post-neutralization—forget about putting in costly equipment for pulp mixing, retention and reduction.

SIMPLICITY: Steeping done at room temperatures. Steeping period 1-14 days (while in storage or shipment). Bleached pulp sent directly to furnishing operation. Yields on groundwood and chemical pulps close to 100 percent.

How It Works. Becco technique can be used on groundwood, unbleached sulphite, semi-chemical, partially bleached sulphite or kraft pulp sheets. Details vary slightly. Take groundwood as an example:

FORMULA MAKEUP: Typical bleach formula for groundwood pulp has 1.0-1.7 percent of 50 percent hydrogen peroxide, 4-6 percent of 41 deg. Be. silicate of soda, a bactericide or fungicide (in warm weather or where slime conditions exist).

Peroxide is the active bleaching agent. Silicate acts as an alkali, stabilizes the peroxide, gives protective coating to iron equipment.

BLEACH APPLICATION: Peroxide and silicate solution pumped continuously from storage by a proportioning pump and rotameter. Distributing pipes spray it on pulp sheet or web.

Drawing above shows an applicator for impregnating a high-density continuous web. Pipes spray bleach liquor across faces of top and bottom rolls; nylon brushes spread it evenly; rolls transfer it continuously to both surfaces of web. Solution diffuses into sheet within few hours; winding or light roll pressing helps.

Minimum bleach for thorough two-side application to groundwoods is about 0.0125 gal. per sq. ft. of sheet. Pulp pH starts at about 10.5 but drops to 6.0-7.5 during bleaching. Pulp is neutral at maximum brightness; stability is good.

PULP STEEPING: Bleach-impregnated sheet simply steeps—in sheets or rolls, in storage or shipment—at ordinary temperature. Optimum time is 1-7 days (at 70-80 deg. F). No brightness reversion on 100 percent groundwood after storing 10-14 days; no trouble after storing 6-8 weeks at mill.

When steeping is finished, bleached sheet goes straight to paper furnishing operations. That's all.

More Data. Want more details on how this Becco process works, where it can be used? Write Pulp & Paper Div., Buffalo Electro-Chemical Co., Inc., Buffalo 7, N. Y.

BECCO BLEACHING CAN GIVE THIS BRIGHTNESS

Pulp type	Wood	Percent peroxide	Starting	Bleached
Groundwood	Spruce-balsam	1.5	59	72
Groundwood	Cottonwood	1.4	57	71
Sulphite	Western hemlock	2.0	55	74
Sulphite	Spruce-balsam	2.0	53	80
Kraft*	Southern pine	1.0	70	85
Semi-chemical†	Poplar	1.1	53	65

* Superbleach † Neutral sulphite

Editorial Viewpoints

Guns vs. Butter in 1951

Those who deal with Congress during the coming year will find a different relationship than has existed for some time past. The major problem will not be Industry vs. The Fair Deal. Whatever mandate for social reform Mr. Truman had, or thought he had, will be conspicuous by its absence from legislative proceedings during 1951. Even partisan politics will be less significant than usual on most subjects. Far more significant will be the competitive relation between Industry and the Military.

Development of a defense program of major magnitude will inevitably take a vast quantity of goods from the normal channels of manufacture and trade. As the building up of reserves of equipment and supplies continues, this diversion of goods will be extremely important. Perhaps the biggest task of governmental relations with which the chemical process industries must struggle is that of showing the Congress how to prevent excessive diversion to the military without undue delay in preparedness.

As we make our plans and New Year's resolutions for 1951, we must face this problem frankly and be prepared to fight for what is truly in the public interest.

Six Points for Peace

A third world war is not inevitable. But its threat will become increasingly serious if as scientists and technologists we concentrate all of our thinking on the military problems of defense and destruction. So we were cheered recently to hear an able engineer, who is also a great military genius, discuss the more constructive prospects for peace. Here is his six-point program:

1. Build better intelligence of what is going on behind the Iron Curtain. This means strengthening not only our central intelligence agency on military matters, but also learning more about Russia's science and industry—the real source of her war potential.

2. Build our military establishment to greater strength and efficiency on a permanent and stable basis. Building up and tearing down is wasteful and ineffective. We need an armed force big and strong enough to maintain the peace. But for true strength and resourcefulness we must build better productive capacity and that means better science and technological know-how.

3. Contain Russia so that she can't expand her sphere of influence beyond certain borders now recognized and established. Any move beyond that line will be regarded as aggression and will be punished.

4. Educate the world to know the difference in objectives of the USSR and the democracies. Russia's concept of peace is that the entire world must be of one ideaology—Communism. Ours is that peace is possible if the peoples of the world—Russia included—can be freed from but two fears—those of aggression and starvation.

5. Stimulate industrial and agricultural productivity abroad so that poverty and starvation do not become the catalysts of Communism.

6. Work for spiritual improvement to build up the moral strength needed to dispel doubts and promote international understanding.

All this, to be sure, is a large order. But it is far better medicine for the world than H-bombs, bacterial warfare, and chemical nerve gases. The chemical engineering profession has a double duty—to work for peace but at the same time make sure that the United States is strong enough to fight if necessary for it.

Pitfalls in Emergency Financing

There will be no scarcity of money for any enterprise selected to assist in the manufacture of materials or equipment for the defense program. Washington has set up a very comprehensive fiscal program to take care of any company, large or small, in preparing to fill defense contracts.

The Department of Defense, after a thorough study of the whole problem, has recently announced a very important conclusion as follows:

"In determining what form of financing should be recommended or made available to suppliers, the following order of preference is to be generally observed: (a) private financing (without governmental guarantee); (b) progress or partial payments; (c) guaranteed loans (with financing institutions participating to an extent appropriate to the risk involved); (d) advance payments; and (e) direct loans (if and when authorized)."

Far less obvious are the arrangements which will be made to assist industry in prompt amortization of new construction built at governmental request. There will undoubtedly be more generous provision for five-year write-off of many new investments. But it is not yet clear that this helpful authorization will be forthcoming generally from the National Security Resources Board. It is still less evident how the widely varying practices of the military departments are going to

(Continued)

function as they review requests for this authority when referred to them for recommendations by NSRB.

Before industrial executives make commitments for largely expanded manufacturing facilities, it is going to be very important that this factor of tax write-off be adequately arranged. In many cases a proper tax balance may subsequently reduce the cost and therefore the proper price for military goods. On the other hand, the reverse would be true if a tax write-off were subsequently denied although the price of goods had been fixed with these special credits in mind.

Too hasty acceptance of direct manufacturing contracts or of subcontracts under defense orders may later result in unfavorable cost and tax decisions. Where it is essential that manufacturing begin immediately or that new plant construction be started without completing all negotiations, it is important that suppliers get adequate written assurance of the proper authorities that the price which they can collect from the government will not be unduly influenced by later unfavorable decision in financing, investment write-off, or other renegotiation features. Any one of these can convert a modest profit arrangement into a contract involving serious losses.

It may not always be easy to get adequate assurance from the start, but industry is entitled to it and should stick to its demands for such protection. On the other hand, the governmental officials should understand that such precautions are not prompted by any profiteering schemes to "get rich quick" at public expense.

What About Alternates?

Almost every chemical raw material is scarce. Even such fundamental needs as those for sulphuric acid and caustic soda are not readily supplied. These facts are not new, of course, but they emphasize the necessity for a critical review of alternate raw materials.

It is not quite literally true, but it is almost fair to state that . . . there is no longer an irreplaceable chemical. This means that there are alternate methods and substitute materials which can often permit a process industry to go ahead and to manufacture satisfactory products even when one of its "essential" raw materials is unavailable. Every such possibility deserves consideration these days, well in advance of the time when necessity forces such substitution.

But it is not enough to consider only the new material. It is essential also to consider the corresponding changes in operating procedures and equipment in the plant, even amendments of packaging practice or of providing technical assistance to customers and suppliers.

The chemical management which is ready with alternates is less likely to be caught suddenly in makeshift and unsatisfactory expedients. Carefully planned procedures and alternate materials will make current shortages less burdensome and may later prevent a complete shutdown. Time and money spent now for such planning should prove a good investment.

The New Science Foundation

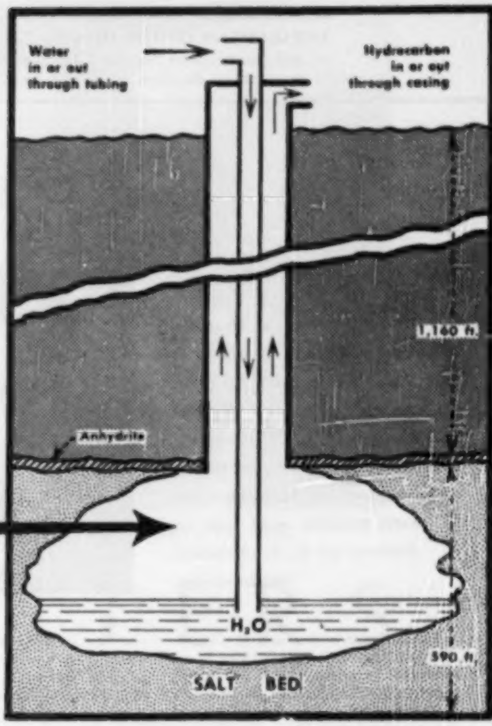
President Truman has nominated 24 distinguished citizens to form the new board of the National Science Foundation. We shall not be critical of their selection even though we urged a larger proportion of engineers from industry. But an examination of the nominees' positions and experience seems to point to one important problem that may well lie ahead.

All but one of the nominees has had longer experience in academic circles than in industry. Only two others were selected from non-academic positions. Charles E. Wilson, president of General Electric Co., seems to be the only nominee of essentially industrial point of view. Even Donald H. McLaughlin, president of Homestake Mining Co., lists his experience in professional positions during many years longer than his active participation in business leadership. Edward L. Moreland is announced as a consulting engineer; but most of us know him primarily as one of the outstanding professors of electrical engineering. The remaining 21 nominees are all connected with colleges, universities, or endowed institutions.

Thus the appointments definitely assure excellent attention to the problem of training young men to become scientific investigators. That is important, but it is only the indirect part of the job of creating new and basic scientific knowledge from which industry may draw later for service to the public. Thus there may well be need for industrial research executives to work closely with the foundation staff in the programming of its research so that research facts (not merely young research workers) will be a clearly recognized objective in the allotment of funds which Congress will be asked to appropriate. The prime objective of the foundation is, or should be, the replenishing of our supply of scientific knowledge.

Even if the board does seem unbalanced in the direction of academic scientists, industry can derive some comfort from the fact that it is not likely to assign an excessive amount of support to the applied research which should be done in industrial laboratories. Obviously, there will be congressional and other pressure in this direction but the present board seems very unlikely to go astray in deciding the difference between fundamental and industrial research. And let us hope that through cooperation within and outside the foundation, the new board can develop programs of maximum value to science as well as to education.

Salt can be dissolved from underground beds to give steel-less and leak-proof storage for liquefied petroleum gases at about one-seventh the cost of steel tanks.



Underground Storage Tanks

W. F. MATHENY AND G. H. BILLUE

Salt caves literally hewn out of the earth by dissolving underground salt formations with water are being effectively used for the storage of propane, butane, and other light hydrocarbons. The process makes use of two facts: (1) certain underground formation such as salt beds or domes, certain shales, etc., are susceptible to dissolving, leaching by water or other solvents, or to mechanical removal; and (2) the greater part of West Texas is underlaid by a massive salt formation of varying depth and thickness. Simply by dissolving out a desired portion of the salt and pumping out the resulting brine solution, a highly satisfactory natural reservoir is formed.

To demonstrate the practicality of such underground storage of hydrocarbon liquids to industry and to the public, an experimental well was set up at the Sid Richardson Gasoline Co.'s Keystone Plant in Winkler County, Tex. In this particular area the salt bed is around 600 ft. thick with the top of the salt about 1,150 ft. below the surface.

W. F. MATHENY *is vice president and general manager of the Sid Richardson Gasoline Co., Fort Worth, Tex.* G. H. BILLUE *is with Hydrocarbon Storage, Inc., Fort Worth, Tex.*

A well was drilled with ordinary equipment to the top of the hard anhydrite immediately overlaying the salt. Fresh water casing was set and cemented in the anhydrite at 1,167 ft. A diagrammatic profile of the storage is shown.

Drilling was continued, leaving open hole, from this depth until bottomed at 1,750 ft. This left open hole in the salt formation. Tubing was then run to 1,700 ft. and the drilling rig removed. Development of the reservoir began by circulating fresh water until approximately 7,000 bbl. capacity was developed. Reservoir capacity was calculated from the volume of water injected and the salt concentration of the return stream.

The maximum per barrel cost of underground storage is $2.50. That's about one-seventh the cost of above ground steel storage. In addition the per barrel cost will decrease as the reservoir size increases and any reservoir thus begun can be enlarged at any time to almost unlimited dimensions. Reservoirs accommodating 50,000 bbl. are now in operation.

The advantages of underground storage over above ground storage are: (1) lower costs, both initial and maintenance; (2) savings in ground space; (3) savings in the use of steel; (4) elimination of above ground operational hazards; and (5) bomb-proof protection for LPG mixtures.

The above reservoir has now been used five times, three of which were demonstrational and observed by representatives of industry and of the services. Specification propane was pumped into the casing with the plant loading pump and a concentrated brine solution displaced from the bottom through the tubing into the bottom forcing the propane out through the casing. While brine displacement was used here, it is obvious there are any number of ways to move products in and out, according to the character of the material, the type energy available and the peculiarities of the vicinity.

In the first test only 95 percent of the product was recovered. In each of the succeeding four times the reservoir was used, well over 99 percent was returned to steel tanks.

The only change in specification of the product due to underground storage was a slight trace of moisture shown on the standard cobalt bromide test.

DEPARTMENT OF THE MONTH. This department appears in each issue among the ads. Are you using it? To call it to your special attention we are starting it here this month

Names in the News

MAN OF THE MONTH

Olaf A. Hougen

Thanks to Senator Fulbright and his annual Awards, America (specifically the University of Wisconsin) is lending Prof. Hougen to the Scandanavian countries for seven months next year to lecture on U. S. chemical engineering.

The ambassador is a natural. Olaf A. Hougen, winner of a State Department sponsored Fulbright Award, will lecture throughout Scandinavia on chemical engineering education and practice in the United States. His qualifications for the job would stop competition in anybody's diplomatic corps.

1. Familiary with basic issues: He has piled up 30 years experience acting as chemical engineering's apostle at the University of Wisconsin. In that time he has done enormous amounts of research, co-authored several basic texts.

2. The diplomatic temperament: His associates will tell you there's no one with a greater interest in people, a greater capacity for making friends. His students verify that by rating him a first class teacher and counsellor on problems that come up inside and outside the classroom.

3. Language facility: He has a good grip on the Norwegian language, thanks to his ancestry. It has been 94 years since his grandparents emigrated. However, when he applied for a passport recently, he was told he didn't need one to go to Norway although he would have to have one to get back here.

Professor Hougen was born in Manitowoc, Wis., in 1893, "Thirty years too late," he says, "to enjoy the era of more horse sense and less mathematics in chemical engineering." Nevertheless, he got himself a B.S. in chemical engineering from the University of Washington and an M.S. and Ph.D. from the University of Wisconsin.

During the first World War he took time out to serve with the Ordnance Department. He was a buck private stationed at Saltville, Va. Their objective there was to make cyanide gas. As Professor Hougen tells it, the workers succeeded only in nearly gassing themselves on several occasions and once blew the top off the laboratory.

(*Continued on p.* 239)

Robert B. Killingsworth. Headquarters staff, Socony-Vacuum Laboratories; has been assistant director, technical service department, Brooklyn. Started with Socony-Vacuum as chemist, 1937. Graduate of University of South Carolina; Ph.D. New York University.

Joseph M. Fox. Waste control engineer for Sharp and Dohme's three Philadelphia plants. Former safety engineer; joined company as junior chemical engineer in 1946. Graduate of the University of Pennsylvania.

David S. Weddell. Former director of development for Monsanto Chemical Co.'s western division, rejoins general development department in St. Louis. To carry on major project investigations. Studied at Pennsylvania State College, MIT (Sc.D., 1941); joined Monsanto as chemical engineer in the phosphate division's research department at Anniston, Ala.

Willis M. Cooper. Assistant director, Monsanto's general engineering department, St. Louis; has been managing director, Monsanto Chemicals Ltd., London. Graduate Iowa State. With Monsanto since 1935 as: laboratory analyst; chemical engineer, Texas City, Tex., plant, then general engineering department, St. Louis; manager of engineering, British operations.

Howard Killam. Director of technical service, American Polymer Corp., Peabody, Mass. Graduate of Tufts College. Formerly with: Dewey & Almey, Union Paste Co.

Thomas E. Moffitt. Assistant works manager of the Tacoma, Wash., plant of Hooker Electrochemical Co. With the firm since 1930, was acting western sales manager during World War II. Graduate of Cornell; active in northwest engineering during 1920's.

John Aaron. Supervisor of the Philadelphia process & method group of E. I. du Pont de Nemours. With Du Pont since 1941 with time out for the Army and an M.S. in chemical engineering from MIT.

L. H. Brandt. Director of technical service, industrial chemicals division, Davison Chemical Corp., Baltimore. Studied at Denison and Ohio State Universities. Previous employers: E. I. du Pont de Nemours; Pennsalt.

Max Birnbaum. Works supervisor at Atlantic Chemical Corp.'s Nutley, N. J., plant. Graduate of Cooper Union School of Engineering. Previously with Port of New York Authority.

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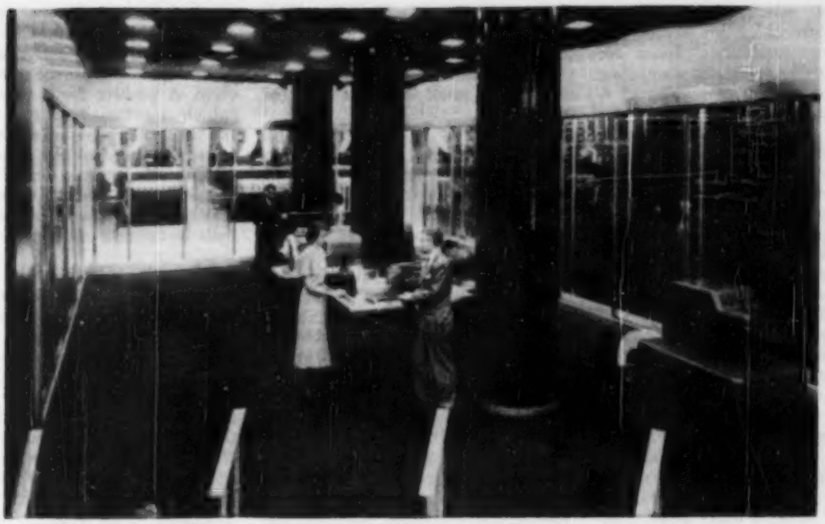

IBM's Selective Sequence Electronic Calculator (SSEC), installed in its headquarters at New York.

COMPUTERS

Recently there has been much news of the big, new high-speed computers, most of it on a popular level—or else at the level of the mathematician. What are these machines, or their smaller, almost unnoticed, cousins going to mean to chemical engineers? We have tried to find out. Here is what we have found.

CHEMICAL ENGINEERING REPORT—DECEMBER 1950

In the last few years, but principally since the end of World War II, everyone who can read has had a chance to become aware of a tremendous development taking place in computing machinery. Except in publications reaching the mathematician, the physicist and the electronics engineer, however, most of what has appeared in print has been of the "oh-my" variety—giant mechanical brains, robots that threaten to take away the working man's living, and vistas of new worlds and wonders without end.

The effect of this hullabaloo on the average work-a-day engineer—or so it seems to us—has been to produce a "so-what?" attitude. Also it has obscured the parallel developments that have been occurring in the analog computers and in automatic business machines. Slowly but certainly the latter have been evolving into relatively high-speed computers. Slowly but also certainly they have emerged from the business office[7] and have been attracting the attention, first of the scientists[2-20]—such as the physical chemists—now of the engineers.

With so much smoke it seemed that there must be fire. Whatever improves science ought logically to improve engineering. Therefore we set ourselves to the task of trying to find out what effects this revolution in computing machinery may reasonably be expected to have on chemistry, the process industries, and the job of the chemical engineer. At the same time we endeavored to untangle the relatively simple ideas underlying computing machines so that any engineer can gain at least a general understanding of how they work and what they will do without a great deal of study.

It is not intended to convey the impression that the details of the individual machines are simple. Many are actually exceedingly complex[1] although their basic ideas are not especially hard to grasp. Further than that, much of the mathematics is extremely difficult, partly because of its inherent difficulty and partly because of the newness of the idea of translating mathematical symbolism into forms the machines can handle. There are, in fact, new professions in process of development: on the one hand the mathematical specialist who can convert often complex mathematics into programs suitable for machine use; on the other hand a new type of engineering specialist[9] who knows mathematics, computers, automatic control and chemical engineering, and can draw from the whole gamut of applied sciences to the end that chemical processes may be made more fully automatic.

We have been able to advance only a short way toward our main objective of finding what the new computers will mean to the chemical engineer and his job. There is evidence that eventually they will mean a great deal, although at present the evidence is primarily logical rather than

drawn from actual practice. A few chemical companies are already exploring the possibilities. Some are already applying automatic computing to a limited number of problems.[illegible] A few plants already have automatic computing ideas built into their automatic controls. A considerable scientific group is already applying automatic computation to problems in atomic physics, spectrum analysis and the development of fundamental tabulations such as those of thermodynamic quantities.[illegible]

New and useful engineering applications will take time to develop. This is true partly because the developments in high speed automatic computation are largely new. It is true, too, because there has until recently been little meeting of minds between the developers of computers on the one hand, and potential engineering users or the other. In the first place, there is a language barrier which is only now being broken down. Secondly, in many cases, computer experts have not known the problems of the engineer; while conversely, the engineer has not recognized the computer as the answer to his problems. To a large extent many engineers are still wedded to the idea of approximations, "slide rule accuracy," and "finagling factors."

Both barriers are gradually giving way. Perhaps one of the most important influences is the computation symposium. International Business Machine Corp. has been holding several such symposiums annually at its Endicott, N. Y., laboratory. The American Chemical Society has recognized the problem and has set up a permanent committee on punched card techniques.[illegible] In addition, computation laboratories are already established or being established in various universities, government departments, and in the computer industry. Some of these are set up to study industry problems and to consult with industrial users.

WHAT COMPUTERS ARE

Computers are devices for obtaining answers to mathematical or logical problems. They range from the abacus, slide rule and desk machine, through the automatic business machines, to the high speed analog and digital computers. Some produce their answers in the form of numbers, and others as physical quantities which may either be translated into numbers, or used directly as control impulses. They range in speed from those manual machines which can be no more rapid than their human operators, to automatically sequenced digital devices that can make several thousands of calculations a second, and analog computers that in some types may give a continuous and virtually instantaneous result from the data fed into them.

There has been considerable discussion as to whether the more highly developed computers can rightfully be compared to the human brain. Some writers such as Wiener[illegible] evidently feel that computers do have certain brainlike characteristics. In general, their thinking must be done for them, although some do incorporate built-in characteristics similar to certain elementary thought processes. Among these may be self-checking circuits, malfunction signals and the ability to make comparisons between numbers on a "greater than," "equals" or "less than" basis. Most types can "learn" by storing information until it is needed. However, if these are species of elementary thinking, still, none of the computing machines can or are likely to be able to do creative thinking, which is one of the main distinguishing characteristics of an actual brain.

COMPUTER TYPES

In classifying computers we find that most types fall readily into one or the other of the two well known groups of digital and analog devices, though some types seem to overlap. Another method of classifying is whether the computer is manually or automatically controlled. Again, some types overlap these classes, as well. A digital machine is one that deals with discrete numbers. Familiar examples include the ancient abacus, operation and revolution counters, desk adding machines and calculators, the automatic telephone exchange, and—interestingly enough—the human brain. An analog computer, however, deals with physical quantities rather than numbers. In some types these may vary continuously and offer continuous results. Familiar analog types include the planimeter, the slide rule and nomograph, some tachometers, the yardstick, and most meters. Writing down a table of observed results is digital; plotting them into a curve is an analog type operation.

In general, digital information is readily converted to analog and vice versa. A slide rule is read, not as a logarithmic plot but as a close estimate of decimal numbers corresponding to logarithms. A tachometer is estimated to the nearest revolution per minute or mile per hour. A watt-hour meter totalizes its revolutions on a digital dial and is read as a closely estimated number of kilowatt-hours consumed in an interval of time. Conversely, dials set at specific numbers can read quantities into analog computers. Numbers can be plotted as a curve. A positive displacement meter (which is essentially digital) can convert its reading by an analog device to rate of flow and can then be read digitally. Hence it is clear that many devices which operate on one basis have characteristics of the other basis built in for ease of set-up or reading.

WHAT COMPUTERS CAN DO

The first and most obvious use for computers is to perform arithmetic and to solve mathematical relationships of various degrees of complexity. Some for example can solve relations that would be insolvable by ordinary techniques. Others get results quickly that would otherwise demand lengthy trial-and-error. Some are so accurate and so rapid that they permit the use of exact and detailed rather than approximate relationships. Thus they produce a quality of result that otherwise might not be achieved in a lifetime of normal calculation.

There are also less obvious sorts of application. For example, a whole class of related devices which are based on the punched card may do no actual calculation at all, but serve only for finding coded information, or for sorting it into categories, or for comparing it on a "greater-than," "equals" or "less-than" basis. Because such devices are often used with computers, they too are considered here.

Computers can also serve as models.[illegible] Within limits it is becoming clear that a computer can substitute for a chemical pilot plant, or an airplane prototype, or an underground petroleum reservoir, or a molecular model. With sufficient experience in such uses it may eventually be possible to feed laboratory data into a computer substituting for a pilot plant, with the assurance that the experimental results gained from the computer will be at least as reliable and at least as suitable for plant design purposes as would the results of an actual pilot plant. If each computer function is accurately chosen to correspond mathematically to the related portion of the plant, then known data can be checked and unknown data discovered by varying computer input to achieve a desired final result. Once the job is completed the computer can be returned to straight computation or its routines modified for other model work.

Finally, as we shall see, there is a coming class of computer use which eventually may bulk larger in the chemical engineer's bag of tricks than

any of the other uses mentioned, and that is in automatic control. Today this class of computer is found mainly in automatic gun directors and similar military uses. Tomorrow it is likely to become a usual item in process plant design.

More than one chemical company and at least one instrument maker is already thinking about computer applications of this sort. MIT is pursuing it actively in its electrical engineering department which has already installed certain *chemical engineering* equipment for research purposes. As yet there is very little known about this class of computer outside of the military uses but it is a safe bet that the idea will be far advanced within a decade. It could proceed much more rapidly if a major war should furnish the incentive.

DIGITAL OR ANALOG—WHICH?

The fundamental difference already noted between a digital and an analog computer is that the first deals with numbers, and the second with physical quantities. That is, the first is an arithmetic machine which deals with numbers in some suitable sequence as called for by the mathematics of the problem. The second substitutes physical quantities such as voltages, angles or lengths as analogs for the numbers which otherwise would represent the primary quantities. It then operates on these physical quantities in a suitable mechanical, hydraulic, pneumatic or electrical network and comes up with an answer which in some types and under proper circumstances can be virtually instantaneous.

Since a digital computer operates sequentially, while an analog machine of suitable type may operate continuously, solving the same problem on continuously varying input quantities, it might appear that analog machines would be the best choice in any case where a computation must be made quickly and repeatedly—as in automatic control. This is not necessarily true for the reasons given below.

In a digital computer the quantities dealt with are numbers and the results—barring malfunctioning—must be as accurate as the input numbers and instructions. Furthermore, digital machines are built to handle numbers of many digits so that the results can be as precise as needed, in addition to being accurate. Finally, many digital machine types can operate at extremely high speeds so that, with the simpler sorts of computation needed in automatic control and in many engineering problems, it is possible to provide repeated solutions digitally at frequent enough intervals for almost any practical need. Thus the discontinuous character of the digital process ordinarily will not bar its use in cases where its achievement of high accuracy and precision are needed.

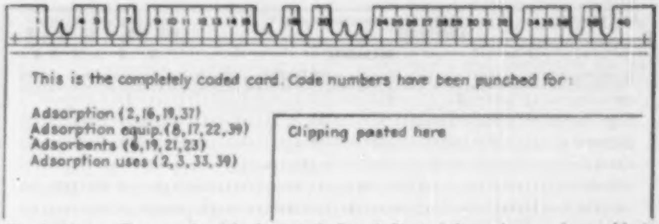

Fig. 1—How a Zator card might be punched to indicate information on four subjects such as adsorption, adsorbents, adsorption equipment and adsorption uses. Codes must be chosen at random. Code number lists are available.

Analog computers, on the other hand, are inherently incapable of either the high accuracy or the precision of digital machines. In the first place, it is impossible to get entirely away from system losses and inaccuracies such as those caused by temperature changes, wear, aging effects, inaccurate electrical characteristics, and the inability to machine working parts to submicroscopic tolerances. And secondly, although the inherent accuracy can be relatively high if enough care is expended in design and construction of the computer, it is still impossible to reach anything like the potential precision of a digital machine. This is because physical quantities can at best be measured and read to only a relatively few significant digits.

The purpose of this discussion is not to cast doubt on the analog computer, but rather to point to limitations that sometimes may rule it out. Against the disadvantages are other factors which often will give it a distinct edge. For example, it will generally be much simpler in a physical sense than a digital machine to do a similar job. In many cases its mathematics is also much simpler since analog components can perform certain operations directly such as differentiation and integration which in digital machines require specialized high-accuracy approximations involving many steps. In general, within the limitations imposed by accuracy, precision and speed, the two types are interchangeable in what they can accomplish so that the peculiarities of the individual application will often govern choice.

DIGITAL COMPUTER PRINCIPLES

One of the first requirements of a digital computing device is that it have a "memory" or storage unit in which to store numbers and working instructions while they are being used. In this sense an analog machine ordinarily has no memory. The simplest type of storage device is the punched card. Several other kinds of storage devices are also used in the larger machines and will be discussed later. But the ideas behind the punched card are fundamental to all of them and therefore should be considered at the outset.

Punched cards can be used for putting information and instructions into computing machines, for taking out results, and sometimes for figure storage at intermediate steps in the process. They are also extremely useful for certain non-computational purposes such as information-finding, sorting and comparing.

There are two general types of punched cards: the edge-punched types represented by the Zator and McBee Keysort cards, used only for manual information-finding and like uses; and the interior-punched types used for automatic sorting and comparison, as well as computing.[7] The IBM and Remington Rand cards are the best known of the latter type.

Edge punched cards, although they have nothing to do with computation, supply a simple, easy and almost foolproof method of coding engineering or other information so that it can be found again with a minimum of effort. As an example, consider the Zatocoding system developed from statistical considerations by Calvin N. Mooers of the Zator Co., Boston. A typical Zatocard measures 5 x 8 in. and contains 40 numbers at the top (or at each of top and bottom). These numbers can be individually punched out with a hand punch, as in Fig. 1. Material to be filed (or a reference to it) is written or pasted on the remainder of the card. Each possible subject in the card collection (up to 91,000 possible subject headings) is assigned a code of four numbers from 1 to 40 which must be picked at random. Since randomness is essential and picking the numbers (without duplicate codes) is tedious, the best course is

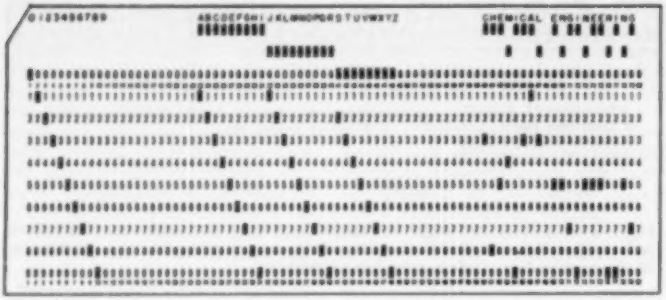

Fig. 2—How an IBM card is punched to indicate digits and the alphabet.

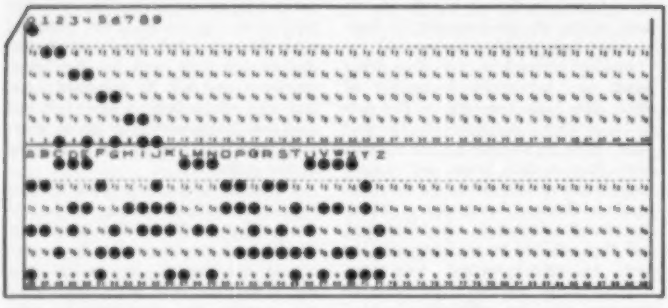

Fig. 3—How a Remington Rand card is punched to indicate digits and the alphabet.

to secure a code number list from the Zator Co.

The subject pasted or referred to on each card is then classified under as many as seven different subject headings and this cross indexing recorded by punching out the code numbers for each heading. It makes no difference if the same number appears twice or more in the several code numbers punched into the card. All cards in the system are then filed, in any order whatsoever. To find all cards on a single subject, skewers are inserted through holes in the bottom of a sorting box, corresponding to the four code numbers of the subject. To find cards classified under the same two or more subjects, additional skewers are added for each additional code number. Cards are then dropped into the box which is vibrated electrically so that all cards with punches corresponding to the skewers will drop down and so be visible when the deck is lifted from the box. About 10,000 cards can thus be scanned in 15-20 min. Occasional "extra cards" may appear due to overlapping codes. However, there will be less than one for each 256 cards sorted against a single code, with a much smaller frequency when the sorting is against two or more codes. Such cards are easily eliminated visually.

Most developments in internally punched cards in the United States have been the work of two concerns, International Business Machines Corp., and Remington Rand Co. These systems were evolved primarily to speed up and mechanize business and accounting procedures, but have been moving into scientific and engineering applications in the last few years.[7] The card systems of both these concerns can be used similarly to the edge-punched cards for finding information, although the uses for the two types are not exactly parallel. The edge-punched type is primarily intended for library type operations, and the center punched card for business and engineering type operations.

Although they are differently arranged and can hold different amounts of information, IBM and Remington Rand cards are based on somewhat similar principles. Both record information by the presence of a hole—or the lack of it, and both stem from an 1889 invention of Herman Hollerith of the U. S. Census Bureau. They are the same size, 7⅜ in. wide by 3¼ in. high and have a corner clipped for identifying the position of the card. The IBM card (Fig. 2) is read electrically by a brush which contacts a roller. For this purpose it is punched with narrow rectangular holes. It contains 80 vertical columns and 12 horizontal rows of punching positions. For numerical representation one of the 10 lowest holes in any column may be used, each position representing a digit from zero to 9. The two upper holes, called the *x* and *y* holes, are used for coding of one kind or another, such as to indicate negative numbers or alphabetical punching. For the coding of the latter (which requires two punches for each letter) see Fig. 2. Here the alphabet is divided into three parts, the first designated by a punch in the *x* row, the second in the *y*, and the third in the 0 row. In addition to the *x*, *y* or 0 punch, each letter requires a punch in the same column in one of the numerical positions from 1 to 9. The 0-1 position is not used. The entire card may be used to express numbers (a total of 80 digits), or designated columns, called "fields" may be used for alphabetical information also. Certain fields may be designated for certain kinds of numbers so that the machines can identify them in subsequent accounting or computation problems.

The Remington Rand system uses mechanical sensing, for which purpose round holes are preferred. This card (Fig. 3) is divided horizontally in the middle into two fields, each containing 45 columns and 6 rows. The card thus offers a total of 90 columns and 6 rows. In order to handle any one of 10 possible digits, 0 to 9, in any column, a system of one- and two-hole punches is used, as in Fig. 3. The top row in any column represents zero and the rows below it respectively (1-2), (3-4), (5-6), (7-8), and (9). To designate zero and the odd numbers, a single punch is used in the corresponding position; but for even numbers the 9 and the corresponding even number are punched in the same column. For example, zero (the top row) or 3 (the third row) will be punched for those numbers, but 9 and 4 (also the third row) are punched for 4. For alphabetical punching two- and three-hole punches are required. Again, as with the IBM card, certain fields may be designated for special sorts of informations.

PUNCHED CARD MACHINERY

Many kinds of operations can be carried out with punched cards and suitable automatic machinery. In general, these include counting, sorting, arranging, selecting, comparing, matching, merging of cards from two sources, and arithmetical operations of adding, subtracting, multiplying and dividing. Many kinds of machinery are produced by both IBM and Remington Rand for these purposes, although the former makes a greater

variety. Some machine types are limited to a certain class of operations, while others are capable of a considerable range of uses. Computing laboratories ordinarily have several types. The principal IBM machines will be discussed to make the principles clear, although it should be understood that in many cases there are comparable Remington Rand machines.

For both systems the original card is punched manually, a column at a time, by key-operated punches which produce a hole in the proper row for each digit or letter desired. Or they may be punched automatically, for example, from teletype tape, or from impulses arising from operations on other cards, or supplied by data-measuring devices such as instruments.

In entering data originally by manual punching, the possibility of human error always exists. With both types of card, verification of the punched data can be accomplished by having a second operator punch the same data into a second machine called a verifier. This machine reads the original card, compares punches, and signals if there is disagreement at any point. There are several other basic ideas in the handling of punched cards that should also be noted. For example, as it is punched, a card can also be printed with corresponding information to enable it to be read visually. (See for example Figs. 2 and 3.) An already punched card can be put through an automatic "interpreter" which reads the punch marks and prints the same information on the card. Or it can be put through a printing machine (tabulator) for printing the information on a sheet of paper. Finally, cards can be transcribed on to teletype tape, with automatic conversion from card code to tape code.

In the operation known as "duplicating" used in original card punching, information that is common to several cards is punched into a master card which is then used to control the automatic punching of this same information into as many other cards as desired. The individual data to be put on these several cards are then punched in manually.

Another similar operation is "reproducing" in which all the information punched into one card is automatically punched on a reproducing punch into a second card. Thus a whole set of duplicate cards can be prepared. The same machine can be used for the similar operation of "gang punching" in which all the information on an original card is copied automatically on to as many blank cards as desired.

One of the simplest manipulations of punched cards is "sorting." An automatic sorter (Fig. 4) takes a deck of cards and examines any single column for punches, routing each card into one of 12 numbered hoppers or a 13th reject hopper, depending on the row in which a punch mark appears. If there is no punch mark in that row the card goes into the reject hopper. If desired the cards from any hopper (for instance, those containing the 7-punch in the 20th column), can be sorted again on another column by moving the reading brush to the desired location. With several such sorts, all the cards punched identically in certain selected columns can thus be removed from the deck. By a slight variation of this technique, a deck can quickly be arranged in a desired order, such as numerical. A shuffled deck numbered from 1 to 1,000 can be arranged numerically in about 6 min.

In sorting, if a column contains two punches, representing such characters as a letter or a coded digit, the sorter routes the card according to the lower punch mark unless the corresponding routing mechanism has been blocked off. Two sorts in each pertinent column, once for the lower and once for the upper punch mark, are thus needed for alphabetical sorting. Sorting operations can be handled at rates up to 650 cards per minute per single pass through the machine. At the same time the number of cards of each sort can be recorded on counters, sub-totalled, and totalled.

Sorting and selecting of somewhat more complex types are handled on another automatic machine known as a "collator." This machine takes two input decks and discharges the cards according to various criteria into four output pockets. In most applications the collator compares three cards at a time, using 80 reading brushes for each card so as to read all columns of the three cards simultaneously. The first two cards from one feed (the primary) are read while the first card from the other (or secondary) feed is being read. By plugging in various kinds of comparison circuits, the cards can be arranged in various ways, or certain cards bearing desired information can be pulled out.

An important type of use of the collator in engineering applications is in looking up tabular data, e.g., trigonometric functions. Suppose that a sine table is to be consulted for values corresponding to 75 different angles. A "table deck," broken down as finely as desired, has a card punched with each angle (argument) and its corresponding sine. Properly arranged, this deck is put into the collator together with an arranged deck carrying the 75 arguments for which sines are to be found. By comparing arguments of the two decks the collator selects only the 75 function cards needed, rejecting the rest. If desired the two decks can be merged so that each argument card is followed by the corresponding function card.

Another important use is in locating data on materials. For example, a deck describing the physical prop-

Fig. 4—IBM electronic sorter in use at the National Bureau of Standards Computation Laboratory, Washington.

Fig. 5—IBM card-programmed calculator in use at the National Bureau of Standards Computation Laboratory. At the rear are the calculator and program unit, at left, the "memory," and in foreground, the tabulator.

erties of say 2,000 organic chemicals can be searched in a few minutes for all compounds boiling at a certain point, or between two temperatures, or above or below a specified temperature. Cards can also be searched for combinations of physical properties, e.g., boiling point, melting point and viscosity. Collators operate at speeds up to 240 comparisons a minute.

ARITHMETIC MACHINES

The machines so far described can perform a variety of manipulations including such logical operations as comparing on a "greater-than," "equals" or "less-than" basis, but they cannot compute. At a later point we shall examine the principles of computing machines, but it is well to note here that among the standard business machines there are several with computing ability. Tabulating machines, for example, not only print the information contained in punched cards but they can also add and subtract the figures they handle, printing sub-totals and totals.

In addition to adding and subtracting, multipliers (multiplying punches) have the ability to multiply. They can handle two numbers in different fields of the same card, or can use master cards to supply constant multipliers. Calculating punches include dividing ability, as well as addition, subtraction and multiplication. Both mechanical and electronic types are made, the latter being much faster. Most of these machines punch their results into another field of the same card or into a blank card. However, some may be hooked up to a tabulator to print the results. All of them can be set up in various ways through use of removable plug boards.

In the case of the most advanced of these machines, the IBM Type 604 electronic calculator, the machine can be hooked up with an auxiliary storage unit and tabulator (accounting machine) to carry out complex mathematical sequences. This arrangement, the card-programmed calculator (Fig. 5), is in effect a smaller, less rapid and less versatile counterpart of the large-scale, general-purpose computers. In most business machines the operation sequences are fixed by the wiring arrangements of the removable plug boards, but in the card-programmed machine both data and operating instructions are put into the machine by way of cards, thus permitting much more versatile programming. The principal limitation of the card-programmed machine as compared with the large-scale general-purpose machines lies in its smaller storage capacity.

NUMERICAL SYSTEMS

Desk calculators operate according to the familiar decimal system in which numbers are represented by ten digits from 0 to 9, arranged at multipliers of powers of 10. That is, the number 671 is a shorthand representation of:

$$(6\times10^2)+(7\times10^1)+(1\times10^0) \text{ or } (6\times100)+(7\times10)+1$$

In calculations based on the ordinary 10-position wheel (as in desk machines of all kinds), there would be no advantage in using a numerical system other than that based on 10. High-speed machines, however, use relay or "flip-flop" devices rather than wheels and when based on the decimal system require more of these components than with certain other systems such as the binary, or variations of it.

Binary numbering is a system based on the number 2. Its two digits are 1 and 0, in which it corresponds exactly to "yes" or "no," to the flow or no-flow of an electric current, or to the presence or absence of a punched hole. In this system numbers are represented as multipliers of powers of 2, just as in the decimal system, except that 2 is substituted for 10. Thus the binary number 101 represents:

$$(1\times2^2) + (0\times2^1) + (1\times2^0) = 4+0+1=5 \text{ decimal.}$$

To represent the decimal number 671 in the binary system requires 10 digits or $(1\times2^9)+(0\times2^8)+(1\times2^7)+(0\times2^6)+(0\times2^5)+(1\times2^4)+(1\times2^3)+(1\times2^2)+(1\times2^1)+(1\times2^0) = 1010011111$. The system is thus rather difficult to translate into decimal notation. This objection can be overcome by the use of certain modified binary systems. These are in fact decimal systems in which the individual decimal digits are expressed in binary notation, but each digit is considered to be a multiplier of a power of 10. They are therefore sometimes called coded decimal systems.

To express any digit from 0 to 9 in binary form requires four binary places (not *decimal* places), as in Table I. Therefore, in the ordinary modified binary system the number 671 is expressed as three groups of binary digits: 0110 0111 0001. These are easily translated into decimal digits since the first digit in each group has a decimal value of 8, the second of 4, the third of 2, and the last of 1.

Table I makes it evident that we can represent up to 16 decimal numbers (0 to 15) with four binary places. This means that the last six numbers are not needed in a modified binary system. One method found in computing machines (the so-called excess-3 notation) takes advantage of this fact to use the first three binary num-

Table I—Binary Notation With Four-Digit Numbers

Decimal	Binary	Decimal	Binary
0	0000	9	1001
1	0001	10	1010
2	0010	11	1011
3	0011	12	1100
4	0100	13	1101
5	0101	14	1110
6	0110	15	1111
7	0111	16	10000
8	1000		

bers for coding, and the next ten for the digits 0 to 9. Thus the binary numbers 0000, 0001 and 0010 are available for instructions, while the decimal digits are 0=0011, 1=0100, 2=0101, etc.

For each decimal place in a modified binary computer there must be four counting devices, or registers, one for each binary place. In use, each register that is "on" will indicate a 1, and each register that is "off" will indicate a 0. If the straight decimal system were used there would be ten counting devices for each decimal place, that is, one to express each possible digit in the decade. Because of the need for auxiliary devices, the saving in machine parts in the modified binary as compared with the decimal system is not quite as great as the ratio of 4 to 10 registers per decade would suggest, but it is substantial. Various methods of mechanizing such a counting arrangement are possible, some of which will be discussed later.

BINARY ARITHMETIC

Binary arithmetic is extremely simple. Ones and zeros are added, subtracted, multiplied and divided exactly as in decimal arithmetic, except that $1+1 = 10$, which means 0, and 1 to carry. Conversely, $10-1=1$, which takes care of the "borrowing" problem in subtraction and division. Actually, most calculating machines do not subtract in the usual longhand fashion. In decimal systems subtraction consists in adding the "nines complement" of the subtrahend to the minuend, then subtracting 1 from the resulting lefthand digit and adding it to the righthand digit of the remainder. This is the so-called end-around carry. The nines complement of any decimal digit is the number that must be added to that digit to total 9. Thus the nines complement of 026 is 973. To subtract 026 from 201, add $201+973=274$. Subtracting 1 from the lefthand digit 2, and adding it by end-around carry to righthand digit 4 gives the correct remainder of 175.

In the binary system the corresponding method of subtraction is by ones complements. This works exactly as in the decimal example, except that 0 is the complement of 1, and 1 of zero. Again the end-around carry is used. To subtract 0100 (decimal 4) from 1001 (decimal 9) add 0011 to 1001 and carry the lefthand 1 to the right, giving 0101 (decimal 5).

OTHER NUMERICAL SYSTEMS

Although it is possible to base an arithmetic system on any number, for example 12 or 20, only a few systems

Table II—Biquinary and Octyl Notation Compared With Binary

Decimal	Biquinary	Octyl	Binary
0	00	0	000
1	01	1	001
2	02	2	010
3	03	3	011
4	04	4	100
5	10	5	101
6	11	6	110
7	12	7	111
8	13	10	1000
9	14	11	1001
10	100	12	1010

other than the binary, modified binary and decimal have been considered for computers. One of these is the biquinary, another the octyl. Table II lists the first 11 digits of these two systems in comparison with decimal and binary notation. The biquinary system has been used by the Bell Telephone Laboratories in computer design because it needs only seven registering devices (relays) to represent a decimal decade. There are two groups of relays, one group of two valued at 0 and 1, and a group of five valued at 0,1,2,3 and 4. Combinations of two relays, one from each group, are used to represent each decimal number as the table indicates. This being the case, it is easy to make such a set-up self-checking by auxiliary contacts and a circuit which shows whether more or less than one relay in each group is operating at any time.

The octyl system has the advantage of being readily converted to binary, and vice versa. Furthermore, each octyl digit, 0 to 7, can be expressed by a three-digit binary number instead of the four-digit binary needed to express the ten decimal digits.

MECHANIZING ARITHMETIC

There are three important types of choice that must be made in solving the problem of mechanizing arithmetrical operations. The first is the choice of a method of procedure which is adapted to machine handling. The second is the choice of the actual mechanical, electrical and electronic elements that are to be used, and their hook-up as a machine. Third is the choice between two possible ways—serial and parallel—in which the machine is to perform single operations such as addition or subtraction. In adding, for example, serial operation means that each column of digits starting at the right is added serially, with the carry transferred to the left, as in manual addition. Parallel operation means that all columns are added simultaneously, with the carries accumulated, then added in when the main addition is completed. On numbers of many digits parallel operation is obviously more rapid. It is used in several machines.

Methods of manual arithmetic in general are not well adapted to automatic computing. In adding a column of figures, a human calculator notes mentally that 3 plus 4 is 7, plus 2 is 9. The machine process, however, is one of counting: Three impulses are fed into a register, then four and then two, so that the accumulation equals nine. All digital adders work in this fashion, although in some the process is not entirely obvious.

Similarly, in subtraction, a human calculator recognizes that 9 minus 7 equals 2. In a machine this process is either one of running the machine backwards to subtract a number of individual impulses equal to the subtrahend, from a register containing the minuend; or else it involves adding the complement of the subtrahend as already noted.

In multiplication a human calculator operates with a mental multiplication table. As a matter of fact, some of the business machine calculators (as well as the ENIAC) actually do the same thing: use a built-in multiplication table. However, with most machines, including most high-speed calculators, multiplication is a process of repeated addition, that is, repeated counting. To multiply 6 by 7, for example, the machine will add 6 to itself seven times by introducing six groups, of six additional pulses each, to a counter already containing the multiplicand 6.

When a human computer performs a division he uses successive steps of trial-and-error multiplication and subtraction for each digit of the decimal quotient. In a machine one of several processes may be used but the effect in general is similar to the human method. For example the process may consist in repeated multiplication of the divisor and subtraction of the product from the left end of the dividend, until the next operation would yield a negative number. Then the machine steps one place to the right, brings down a digit as in ordinary long division, and operates similarly on the remainder. Another method is to calculate the reciprocal of the divisor by means of a series and multiply the reciprocal by the dividend.

It is interesting to note that the first of these methods requires "judgment" on the part of the machine, namely, ability to tell when the next number would be negative. This is an example of a "less-than" comparison as already mentioned.

The last of the simpler arithmetical operations, sign recognition, is accomplished usually by giving the input number a code indication which the machine can interpret as plus or minus. As operations continue, the en-

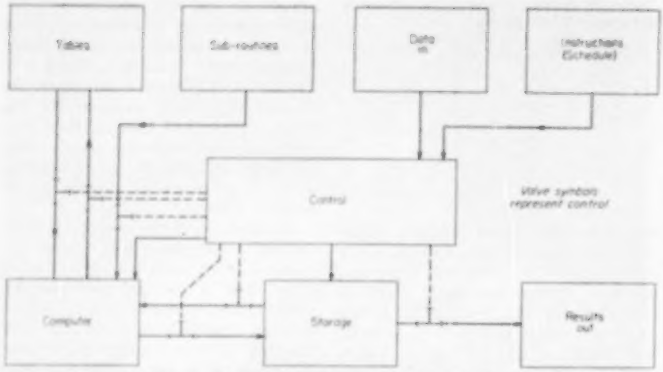

Fig. 6—Schematic diagram showing how the main functions of an automatic digital computer are organized, indicating lines of control.

suing numbers continue to carry their signs. Sign recognition is often the basis of "more-than", "equals" or "less-than" recognition in the machine. These abilities of the computer are important, since in many problems a number of alternatives will be offered for the next operation, depending on the sign of a number or the relative magnitude of two numbers.

Machines have various methods worth noting here for deriving some of the other mathematical relations and functions. Powers are calculated by multiplication, while roots and reciprocals are obtained by evaluation of convergent series. These can be carried out by iterative processes involving only multiplication and subtraction. Logarithms, exponentials and trigonometric functions are also determined by evaluating series. Where a function can be obtained by a standard process of series evaluation, machines are often provided with a "sub-routine" in the form of an already detailed program of instructions which can be "plugged in" in response to a code signal.

An alternative to the sub-routine method of calculating functions that is used in some of the machines is to provide "function tables." A table of sines for example can be punched into tape and installed in a reading device which will scan the tape and locate the desired value whenever a proper signal is issued.

COMPUTER ORGANIZATION

Any automatic computer must have elements which are counterparts of the human computer and his equipment. For fairly detailed problems a man will need a work sheet, tables of functions and a desk calculator. So will the machine, except that as a substitute for the man's mind, it will need instructions and control, while the man's work sheet will become the machine's storage system.

Fig. 6 shows a rough diagrammatic approximation of the automatic computer equivalent of the man and his tools. For the machine, all instructions must first be set up as a schedule by the human computer. They and the control unit together then manage each step of the machine's operations. Function tables may actually be provided as the diagram suggests, or instead the machine may use sub-routines to calculate needed functions.

As a minimum the computer must be able to store numbers and instructions, add, multiply, recognize signs, determine equalities, and transfer information from one storage point to another. Subtraction can be handled as already noted by adding complements, and division by iterative multiplication and subtraction.

In many machines at least a part of the storage capacity is indistinguishable from the computing elements themselves. This comes from the fact that any registering device that can assume either of two positions or states, such as "on" or "off", will store the information corresponding to its position until called on to give it up. (Provided, of course, that a power failure does not cause it to assume the opposite position.)

From this discussion[4] it is clear that the automatic computer must have: (1) Input facilities for introducing properly coded data; (2) input facilities for coded instructions, including sub-routines and tables; (3) storage capacity for input and intermediate data, and instructions; (4) a unit or units for arithmetical and recognition operations; (5) a control unit for acting on the instructions and transferring information between various parts of the machine; and (6) an output unit able to translate results in machine code into understandable output data. Some of these functions may overlap and may not be clearly distinguishable.

COMPUTER COMPONENTS

Within our space limitations it will be impossible to do more than touch on the great variety of devices used to perform the six functions of a digital computer. Their actual organization tends to be extremely complex and many different combinations of elements are used. However, a general idea of what they are, and how they work will be helpful in giving an over-all picture.

Input-Output Schemes—There are two main aspects of the input problem: (1) Determining the schedule, and (2) coding input data and instructions for entry into the machine. The first problem is the difficult one. It involves first a thorough knowledge of what the machine can do and how it does it; and second, a knowledge of the many sorts of mathematical manipulations that will translate an actual problem into operations the machine can perform. These include various transformations and the use of series, repeated approximations and other iterative techniques. Fortunately, many standard manipulations have been developed and so need not be worked out individually by the user. Apart from the standard manipulations, however, much mathematical ingenuity may be required in setting up a schedule for a complex problem. It is quite possible for the scheduling to take much more time than the actual machine operation.

Once the schedule is set up, putting data and instructions into the machine becomes routine. Various methods are used including (1) Plug-board set-ups, (2) switch settings, (3) punched cards, (4) punched tape, and (5) magnetized tape. Of these, punched cards and tape, and magnetized tape are also used for reading in tabulated function data. Cards and tape are punched by key-boarded punching machines which translate digits into machine code. Suitable fields of the cards or tape can be chosen for data, signs and for instructions. Instructions of all kinds are indicated in numerical code when the schedule is first set up.

Removable plug boards are a characteristic of IBM machines. Such a board may be set up in advance and plugged into a machine as a unit. Thus it requires only a moment of machine time to introduce a whole schedule or sub-routine. These boards contain a great number of sockets which are interconnected as needed, using short wires equipped with plugs.

Paper tape is handled similarly to punched cards, except that it is continuous and is punched across the tape, usually in binary numbers, with the tape width divided into an appropriate number of fields. The machine's tape reader can then read a line at a time and so absorb several coded pieces of information simultaneously.

Magnetized tape is becoming an important computer element, both for reading in and out information, and for storage. It will be discussed in more detail later. Suffice it to point out here that the presence or absence of a magnetized spot can be used to represent 1 or 0, and hence numbers expressed in binary code. Magnetized tape is rapid to record and read, as well as permanent, yet it is easily "erased." With it more computer information can be stored per cubic inch of space occupied than by any other known method.

In a sense, machine output is the reverse of the input process. As called for by the instructions, numbers held in the machine are transferred to output devices which in some types punch the result in cards. Others translate from machine code to decimal numbers and print the result. In business machines, for example, one function of the tabulator is the producing of a printed output.

Arithmetic Schemes—The simplest of all digital computing schemes is the ten-position or decimal wheel used in adding machines and other mechanical computers. One wheel is used for each decimal place needed and the wheels are geared together so that a complete revolution of each wheel will cause a carry of 1, that is, one-tenth revolution of the adjacent wheel at the left. By means of a detent each wheel is constrained to move in discrete steps of exactly one-tenth revolution so that the corresponding digits of 0 to 9 on its periphery can be read. Using a wheel train for computing consists in adding by feeding a number of mechanical impulses from 0 to 9 into each wheel, each impulse causing one-tenth of a revolution. Multiplication is by repeated addition, subtraction by reverse operation or by adding nines complements, and division by repeated subtractions.

With the exception of the earliest automatically sequenced calculator, the IBM-Harvard Mark I, the mechanical wheel system is not used in large scale computers. However, its principle is significant since a comparable idea can be used with an electromechanical or electronic equivalent of the wheel. The simplest concept to grasp is the use of a combination of relays as the electromechanical wheel equivalent. A slightly more complex idea is the substitution of electron tube combinations (called flip-flops) for the electromechanical relays. Relays can operate much more rapidly than wheels, and flip-flops in turn much more rapidly than relays.

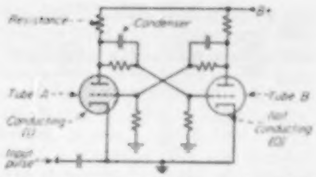

Fig. 7—Diagram illustrating an elementary flip-flop circuit. Trigger arrangements must be added in an actual circuit.

In the decimal system a cascade of ten relays or ten flip-flops is necessary to be the equivalent of a single wheel. Bell Labs relay computers using the biquinary system require seven relays (see Table II) per decade. A straight binary system requires only one relay or flip-flop to represent a binary digit of 0 or 1 but this comparison needs interpretation in the light of the fact that it takes, on the average, 3⅓ binary digits to represent a decimal number.

In a modified binary system it has already been shown (Table I) that a number of four binary digits will express any single decimal digit. Therefore such a system requires four relays or flip-flops to be equivalent to a wheel, plus such extra elements as are needed to "lock" the system after the ninth impulse and bring about a carry.

An electromechanical relay can be used as a computing element because it can assume two stable states, one with its contacts open, and the other with them closed. This is the equivalent of 0 and 1 in the binary system. A groups of relays can be cascaded in various ways depending on the arithmetical system chosen. A decimal system would be hooked up so that the first impulse fed into the first relay of the series would close its contacts, while the second impulse would open the first relay and close the second. Similarly, subsequent impulses would each close a later relay in the series, leaving those before it open. Finally, the tenth pulse would open the last relay in the decade and send a carry pulse to the next decade.

The existence of a number in such a decimal register consists in some particular relay (but only one) being in the closed condition. This condition can be stored as long as desired. However, addition of a second number in the form of a train of impulses will step through the sequence, starting with the relay containing the first number, so that the final relay pulsed will be the one representing the sum of the numbers.

VACUUM TUBE COMPUTING

A modified binary sequence of four relays would be arranged somewhat differently, in that it would be necessary to enable combinations of relays to be closed simultaneously to represent the 10 decimal digits in binary notation. As Table I shows, the combinations require from zero to three relays to be closed at the same time.

Electron tube flip-flops, generally composed of vacuum tubes, can be used as the equivalent of relays. A vacuum three-element tube (triode) is normally able to conduct at widely varying rates depending on the control potential applied to its grid. Therefore, it requires a special hook-up known as a flip-flop to make it capable of having only two stable states, namely, not conducting and fully conducting. Gas filled triodes (thyratrons) inherently have but two stable states and would be excellent for computer use if they were not rather slow in action.

A simple flip-flop appears in Fig. 7. It is shown with two separate triodes, but in actual practice the two triodes are combined in a single envelope. With this arrangement only one tube can conduct at a time. If tube A is conducting, then the entry of a negative pulse into the system will extinguish conduction in tube A and start it in tube B. Each succeeding pulse reverses the system. By combining such an arrangement with a second double triode used as a trigger tube, several kinds of flip-flops can be constructed.

In all of these, successive pulses cause the device to assume the other of its two stable states. In one type there are two input leads and the second pulse must be received on the second lead to be effective. This is a "set-reset" arrangement used mainly for switching. Another type with a single input lead will give a negative output pulse on one output lead when it "flips" with the first input pulse. Then it will give a positive output pulse on another lead when it "flops" with the second input pulse. Use of both output pulses can indicate positive or negative signs. By using only the positive output lead of such a flip-flop and connecting it to the input of the next counter in a series, a counting circuit of any desired number of flip-flops can be built up.

Assume such a circuit of four flip-flops, shown schematically in Fig. 8. In each counter, if tube B is initially conducting and tube A is blocked, the value is 0. When the first counter

is pulsed it changes from conducting *B* to conducting *A* and a value of 1. This is the "flip" referred to above and there is no positive output pulse and hence no effect on counter (2). With the second input pulse to the first counter, it "flops", that is, changes from conducting *A* to conducting *B* and assumes a value of 0. At the same time it pulses counter (2), changing it to a value of 1, but issuing no output pulse from (2). Thus each counter gives an output pulse only in changing from value 1 to value 0. A succession of ten pulses therefore cycles the four counters as indicated in the schedule below the counter symbols. It is clear from the schedule that this is a binary counter.

For performing straight decimal arithmetic (as in the ENIAC) ten flip-flops are used, generally arranged in a ring. The first, in the conducting *B* state, gives a positive indication of 0. When the tenth is pulsed it returns to 0 and issues a carry pulse to the next decade.

The arrangement shown in Fig. 8 would of course count to 15 as we have previously seen. Actually it is provided with a lock tube and carrying arrangements which cause the tenth pulse to clear counter (4) and carry a pulse to the next decade. Thus it becomes the modified binary (or coded decimal) system already described.

What we have just considered is a very brief and inadequate description of the underlying ideas in vacuum tube computing arrangements. Many arrangements have been devised and these must be combined with switching devices to enable numbers and coded instruction to be switched between different arithmetic, control or storage units or between storage and input or output. Switching devices include principally manual switches and plug boards, relays, and vacuum tube "gates". A gate is any electronic circuit having two input leads and a single output, so designed that an output pulse will occur only when two input pulses occur simultaneously. Note that this is not the same as the "set-reset" flip-flop already mentioned.

An example—somewhat oversimplified—of the application of switching devices in a computing circuit occurs in the sort of arrangement used to move a number from one point to another. Suppose the number 2 is stored in one decimal register and it is desired to transfer (add) it into another decimal register containing the number 5. The problem is to cause the first register to send two pulses to the second register. The system contains a pulse generator supplying say 100,000 pulses per second. By feeding these through a decimal counter controlled by an electronic switching arrangement, exactly 10 pulses can be counted and fed into the first register containing the 2. This register cycles through 0, at which point it gives out a signal that switches the remaining two pulses of the original 10 into the register containing the 5, thus adding in the 2 and giving the total of 7.

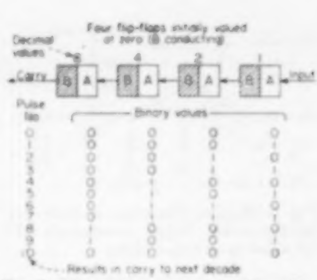

Fig. 8—Schematic arrangement of four flip-flops counting on a modified binary system, showing decimal values corresponding to binary values as the counters step through numbers from 0 to 9.

The same general principle is responsible for all transfers of numbers within computers. It can be used also for subtraction by reversing the switching scheme so that the first eight pulses rather than the last two will enter the second register, which cycles it through 0 back to 3, giving the desired difference by adding the tens complement (nines complement plus end-around carry).

Storage Schemes—All automatic digital computers have facilities for storing input numbers, intermediate numbers and instructions. We have already seen that some storage occurs in the arithmetic elements themselves, while function storage can be handled with punched cards and tape, and magnetic tape. This is not enough for the large-scale machines, however, and several ingenious storage systems have been developed. Most machines use more than one kind of storage, for example electronic arithmetic units plus relays, or arithmetic units, magnetic tape and delay lines.

One very novel concept used in several machines, including the Univac and SEAC, is the sonic delay line. A train of spaced impulses in the form of vibrations can be sent through a column of fluid such as mercury. The vibrations are then picked up at the other end after an appreciable delay and reconverted to electrical impulses. Until they need to be read out, the emerging impulses are simply fed back into the delay line and continue to recycle in the circuit. The scheme is rather similar in effect to the use of magnetized tape on a rotating drum, although it is available more quickly. Magnetized tape, both in reels and secured to the surface of a rotating drum, makes an excellent storage device. The principle here is similar to the tape or wire recorder. Tape moving through a magnetizing head can be magnetized in spots if subjected to a momentary field. This constitutes a binary system since a magnetized spot represents 1 and an

High-Speed Digital Computers in U. S., Built or Building

The first five types of computer listed are relay machines. All others are electronic, or primarily so. There are 23 types listed, with four types duplicated to a total of 33 machines completed or in various stages of design or construction.

1. IBM-Harvard Mark I: Built by IBM for Harvard, 1944; installed at Cambridge, Mass.
2. IBM Pluggable Sequence Relay Calculator: Four built by IBM, 1944 and 1945; two for Army Ord. at Aberdeen, Md., two for Watson Scientific Computing Lab, Columbia University, New York.
3. Bell Labs Computer V: Two built by Bell Telephone Labs, 1946 and 1947; one for Army Ord. at Aberdeen, one for NACA at Langley Field, Va.
4. Harvard Mark II: Built by Harvard 1947 for Naval Proving Ground, Dahlgren, Va.
5. Bell Labs Computer VI: Built by Bell Labs for own use at Murray Hill, N. J.
6. ENIAC: Built by Moore School, University of Penn., 1946, for Army Ord., at Aberdeen, Md.
7. IBM Selective Sequence Electronic Calculator: Built by IBM, 1948, for own use in New York; operated by Watson Lab.
8. BINAC: Built by Eckert-Mauchly Computer Corp., 1949; installed at Northrup Aircraft, Inc., Hawthorne, Calif.
9. Harvard Mark III: Built by Harvard, 1949, for Naval Proving Ground, Dahlgren, Va.
10. Whirlwind I: Built by MIT Servomechanisms Lab for Office of Naval Research, at Cambridge, Mass.
11. EDVAC: Built by Moore School, University of Penn., for Army Ord., Aberdeen., Md.
12. Raytheon SDC: Being built by Raytheon Mfg. Co. for Offices of Naval and Air Research, at NBS., Washington, D. C.
13. IAS Digital Computer: Being built by Institute for Advanced Study for Army Ord., ONR and OAR for use at IAS, Princeton, N. J.
14. ORDVAC: Being built by University of Illinois for Army Ord.
15. University of Illinois Computer: Being built by University of Illinois for own use at Urbana, Ill.
16. California Digital Computer (CALDIC): Being built by University of Calif. for ONR, for use at Berkeley, Calif.
17. Zephyr: Being built by NBS Institute for Numerical Analysis for use at INA at Univ. Calif. at Los Angeles.
18. Standards Eastern Automatic Computer (SEAC): Built, 1950, by National Bureau of Standards for own use at Washington, D. C.
19. Los Alamos Computer: Being built by Los Alamos Lab for AEC for use at Los Alamos, N. M.
20. Harvard Mark IV: Being built by Harvard for Office of Air Research, at Cambridge, Mass.
21. GE Computer: Two designed by General Electric Co.
22. Barber-Colman Computer: Designed by Barber-Colman Co., Rockford, Ill.
23. Univac: Six computers on order from Eckert-Mauchly Computer Corp., Philadelphia, Pa. Tests on Univac No. 1 for NBS now being completed at the factory. Construction under way on others.

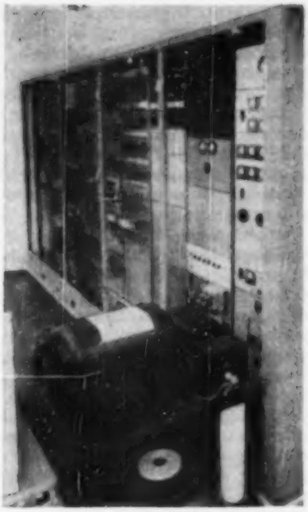

Fig. 9—National Bureau of Standards Eastern Automatic Computer (SEAC) with input-output equipment in the foreground.

unmagnetized spot 0. Or, preferably, the entire tape is magnetized in one direction and the spots reverse-magnetized to facilitate erasure. Any sequence of spots and no spots can be read out by a magnetic reading head as needed. They are then either retained, or erased by an erasing head, as desired.

LARGE SCALE MACHINES

An accompanying table lists the more than 30 large scale automatic digital machines now in existence in the United States or in the design or construction stages. A few comments regarding some of these will bring out some of their special features.

First of the automatically sequenced machines was the IBM-Harvard Mark I, developed jointly by IBM and Harvard University. A relatively slow machine requiring about 0.3 sec. to add two numbers, it uses electromechanically controlled and read wheel counters. First of the true high speed electronic machines was the ENIAC, designed and built at the University of Pennsylvania by J. W. Mauchly and J. P. Eckert. It makes use of 1,500 relays and 18,000 vacuum tubes, yet has a fairly small storage capacity compared with later machines with many fewer tubes. Its arithmetic is decimal and its basic speed is the addition of two numbers in 0.0002 sec.

The only large-scale machine at present operated by a commercial concern on a consultive basis for clients in science, industry or commerce, is the SSEC which was designed and built by IBM and installed in its New York headquarters. This machine (see frontispiece) is operated by the Watson Computing Laboratory which is maintained by IBM at Columbia University. It uses modified binary arithmetic, a very large relay and punched tape storage and can add two 19-digit numbers in less than 0.001 sec.

One of the most novel features of the SEAC, the Natural Bureau of Standards general-purpose machine recently completed at Washington (Fig. 9), is its use of germanium crystal diodes rather than electron tubes for all switching and computing. For storage it uses mercury delay lines as well as a novel type of electrostatic storage tube. It operates on the binary system, is the fastest general purpose machine now operating, and can complete an addition of 11-digit numbers in about 0.0009 sec.

Tests are now being completed on the first model of the Univac built in Philadelphia by the Remington Rand subsidiary, Eckert-Mauchly Computer Corp. Six of these high-speed, general-purpose machines are on order. Some of the features include use of the excess-3 arithmetical system; extensive application of magnetic tape for input, slow-speed storage, and output; and a high-speed storage capacity for 12,000 digits in mercury delay lines. Read-in and read-out speed is 10,000 digits per second and the basic addition rate is one addition in less than 0.0006 sec. Univac No. 1 is undergoing several months of testing. Its "mercury memory" appears in Fig. 10.

ANALOG COMPUTERS

We have seen previously that any analog device operates on the basis of physical quantities instead of numbers and that these quantities can be expressed more or less accurately and precisely as numbers. Most methods of measurement are analogical so that it is not surprising that many computing schemes should have been developed to combine measurements directly and continuously in certain mathematical relationships and produce continuous answers, often as control impulses. This instrument type of analog represents one broad class.

A second broad class is the mathematical machine, designed primarily to solve more or less complicated mathematical problems as computers or as simulators. Most highly developed of this group are the MIT and other differential analyzers. Others of the group are more restricted in purpose, often solving only a single class of problem. Examples include the network analyzers such as those used in the electrical industry to simulate distribution networks, Columbia University's heat and mass flow analyzer, and the simultaneous equation solvers."

There is no fundamental difference between the underlying ideas of instrument type analog computers and those that are chiefly mathematical or simulating machines. The same

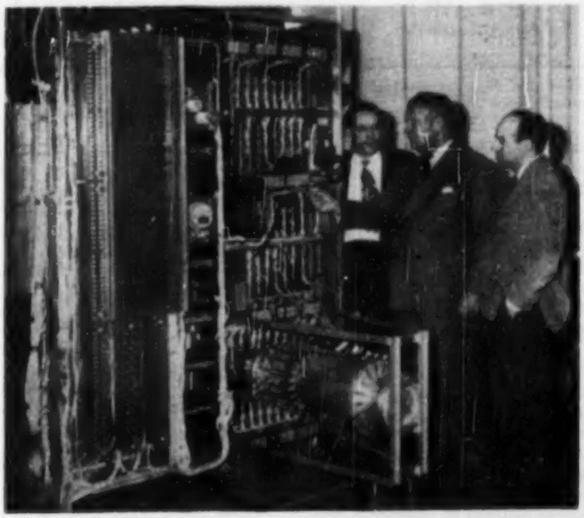

Fig. 10—J. W. Mauchly and J. P. Eckert, of Eckert-Mauchly Computer Corp., show the Univac's 12,000-digit mercury delay line storage unit to Lt. Gen. L. R. Groves of Manhattan District fame, now a Remington Rand vice president

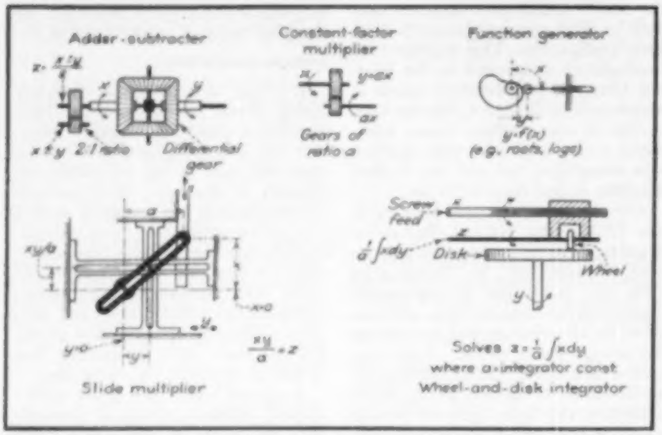

Fig. 11—A few mechanical analog calculator elements including an adder-subtracter, multipliers, and a wheel-and-disk integrator.

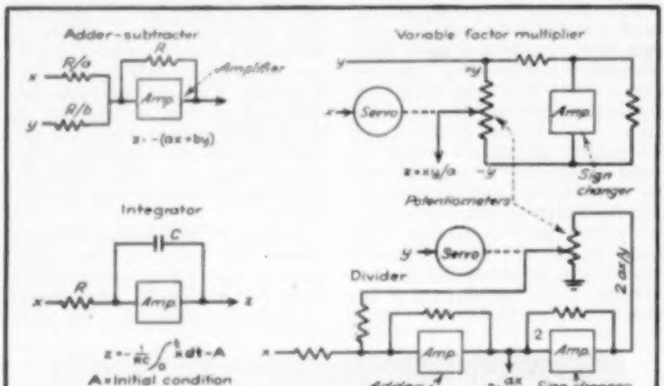

Fig. 12—A few electrical methods of solving problems in addition, multiplication and integration (much simplified).

machine can sometimes be used both ways. The main divergence is likely to be in method of use: In the first type data will usually be fed in continuously to produce a continuous result; while in the second the machine will be set up manually with instructions (arrangement of elements) and input data which may however be varied to give a number of solutions.

ANALOG COMPUTER ELEMENTS

Velocities, and linear and angular displacements of mechanical elements as well as pressures such as those of fluids or of electricity (voltage), are some of the quantities that can be used as analogs. Fluid pressures are commonly applied in analogical fashion in industrial instruments, some of which have elementary computer characteristics (e.g., derivative-action controllers). Mechanical elements and electrical quantities such as voltages are the analogs used principally in the devices thought of as computers. Analog elements can add, subtract, multiply, divide, differentiate and integrate. They can also generate functions and simulate such non-linear characteristics as hysterisis, dead spots and back-lash. Although most analog computers are designed to deal with a single problem or limited class of problems, there is no inherent reason why analog elements cannot be assembled so as to solve virtually any problem.

MECHANICAL ELEMENTS

There are a large number of mechanical elements that can be used to solve the relations of arithmetic, algebra, and calculus, to extract roots, and to generate functions such as logarithms, trigonometric functions, empirical relations, and exponentials.[20] In general, these consist of cams, gears, linkages and wheels. At present it appears that most mechanical analogs are becoming less important, while electrical and electronic devices are on the ascendancy, so that only a brief description of a few fundamental types will be given here.

To give some idea of the range of mechanical elements, Fig. 11 diagrams the principles of one method for each of the operations of adding, multiplying a variable by a constant factor, generating functions, multiplying two variable factors, and integrating. A differential gear will add or subtract two velocities of rotation, x and y, to give $(x \pm y)/2$. A gear ratio a will serve as a constant multiplier of velocity x to give ax. Cams of many sorts including external and internal cams, and slots, can mechanize many continuous relations of the type $y = f(x)$, including empirical relations. Multiplication of two variables, x and y, can be solved by a slide arrangement based on similar triangles to give $z = xy/a$, where a is a constant of the machine. In one triangle a and x are respectively base and altitude, and in the other, y and z. Hence $x/a = z/y$. The same device can divide z by y, provided y is not too close to 0.

Although the differential gear continues to be used extensively in analog machines, the integrator is probably the most important of these devices. For one thing, it does a job directly that digital calculators can accomplish only by many-step approximations. Differential analyzers have therefore become an important class of computer. Kelvin is credited with being the first to appreciate that a continuous variable-speed transmission can be used for integration and differention. If y represents the input rotation on the drive side of such a transmission and x represents a function of the speed ratio, then $a\,(dx/dy) = z$, the output rotation, and $Z = 1/a \int x dy$ where a is a constant of of the mechanism.

The simplest such device, Kelvin's wheel-and-desk integrator, is the type of transmission actually used. Various modifications have been introduced to improve its accuracy but the principle remains the same. A single integrator can be used to square a function or produce an exponential or natural logarithm. Two such integrators with their outputs combined by a differential gear (adder) can be used to multiply—or to divide by using the reciprocal of one of the vari-

ables as an input quantity. Two integrators can also generate any power of a variable. Cascaded integrators will solve second or higher degree differential equations.

Largest, and most accurate and comprehensive of the mechanical analog machines, is the second of MIT's differential analyzers, put into operation in 1945. This machine uses mechanical elements but connects them electrically to avoid errors due to slippage under load, and to facilitate hooking up. It consists of a complex assembly of 18 integrators and many gear boxes and adders. Both hook-up instructions and data input can be fed in by punched tape, with results taken out on electric typewriters. It regularly achieves an accuracy of 1 part in 10,000 and sometimes does better.

ELECTRICAL ELEMENTS*

Electrical analog computation is based on the relations between voltages and currents in various electrical circuits. Addition and subtraction can be accomplished by feeding two or more d.c. voltages into a resistor shunted by a vacuum tube amplifier. The output voltage is the negative of the algebraic sum of the inputs. Multiplication of two variables will result if one is represented by a voltage across the outside terminals of a potentiometer, while the other is represented by the position of the movable potentiometer contact, which is controlled by a manual setting or by a servo-motor. Multiplication of a variable by a constant factor can be handled by a potentiometer or by a resistance-coupled amplifier. Division is rather similar to multiplication. A potentiometer or servo-controlled potentiometer can be hooked up with two adders, one acting as a sign changer, so that in effect it multiplies one variable by the reciprocal of the other.

The time integral of one input voltage, or of the algebraic sum of several voltages, can be obtained by shunting an amplifier with a capacitor. This is the same device as the adder except that a capacitor is substituted for a resistor as the measuring device. By properly connecting such integrators in a closed circuit they can solve linear differential equations of any order.

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* Too late to mention here in detail, the Navy has announced the 4,000-tube Project Typhoon computer, developed by the RCA and the Navy's Special Devices Center. This machine is the world's largest electrical analog computer, designed primarily as a simulator for solving military problems in guided missiles, vessels and airplanes. An unusual feature is that the computer incorporates digital as well as analog principles.

In a general way the diagrams in Fig. 12 indicate the methods used in the automatic-recording REAC electronic differential analyzer[46] built by Reeves Instrument Corp., of New York. Adders are ordinarily equipped with several input jacks having separate resistors to give various amplification (constant multiplication) factors. Since an adder gives a negative sum, it is often necessary to follow it with a sign changer, which is merely a single-input duplicate of the adder. To secure automatic multiplication and division the REAC employs a self-balancing servo-motor to control the potentiometer in proportion to the value of one of the variables. Since the servo controls the potentiometer contact in proportion to a fixed reference voltage a supplied to it, a appears in the equations shown. A REAC contains seven integrators and so can handle differential equations up to the seventh order. A standard servo unit includes four servo-motors, two for multiplying and dividing, and two for resolving vectors to enable the machine to handle trigonometric functions. Empirical and special functions can be put into the machine by special-function potentiometers, or by manual tracking of a curve on a drum.

Circuits based on the same general principles diagrammed in Fig. 12 are used by George A. Philbrick Researches, Inc., of Boston, in a line of small analog components which can be combined in many ways for display of the results on an oscilloscope. All units incorporate a sign changer so that both plus and minus values of the result are available. In addition to adders, integrators and multipliers, these components include a differentiator and several special devices to limit the swings of a variable and to simulate process lags, hysteresis or backlash, and dead zone in instruments and mechanisms.

ELECTROMECHANICAL ELEMENTS

Another computer manufacturer, Arma Corp., of Brooklyn, N. Y., also manufactures separate components which are primarily electromechanical rather than electronic. Most of them resemble small motors and consist of motor-like stators and rotors.[49] Included in the list are: (1) Induction potentiometers which add, subtract, multiply, divide, raise to powers and extract roots, in some applications being hooked up with servos and amplifiers; (2) synchro differentials, which add when connected into a self-synchronous motor circuit; (3) induction generators which differentiate and integrate when coupled with induction potentiometers and servos; (4) resolvers, which resolve vectors and produce trigonometric functions; and (5) servomotors, vacuum tube amplifiers for servo power supply, and self-synchronous motors for transmitting data. These devices can be interconnected to compute almost any sort of problem or can be used with continuous input for many kinds of automatic control.

COMPUTER APPLICATIONS

Some of the general classes of application for automatic computing equip-

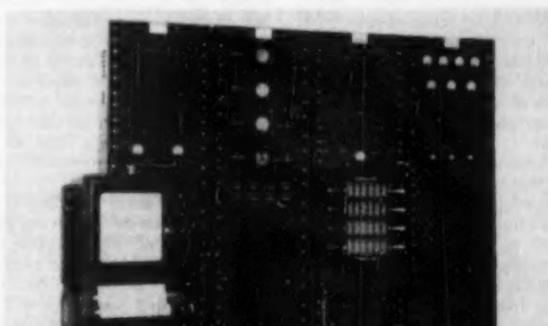

Fig. 13—Reeves Electronic Analog Computer (REAC), showing output unit, calculating section and servo section.

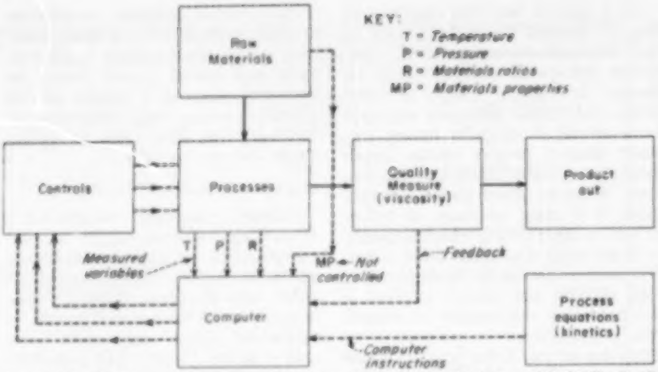

Fig. 14—Block diagram of hypothetical computer-controller hook-up, with feedback of quality measure to govern regular control variables.

ment in the field of chemical engineering have already been considered. In addition to non-computational punched cards uses, these include the speeding up of trial-and-error solutions and the computing of answers that would take too long by non-automatic methods. Computers used as simulators and as models to avoid pilot plant construction have also been mentioned.

Some of the more specific types of problems for computers that have been suggested by various authors include solutions of: (1) Phase equilibria in flash vaporization;[17] (2) complex flow of heat and fluids;[11] (3) differential equations occurring in coincident gas absorption and reaction;[20] (4) distillation column plate computions and reflux ratios in multicomponent mixtures;[18, 20] (5) general problems involving diffusion, many of which cannot be solved without trial-and-error;[20] (6) quality control problems involving computation of means, standard deviations, and control limits[16]; (7) interpretation of spectrometric,[10] X-ray and crystallographic data; catalytic reactor problems.

We have also touched on the suggestion that computers eventually may be expected to play a big part in automatic control. This question has been discussed at some length by Brown and Campbell[9] who have been studying it in the Servomechanisms Laboratory at Massachusetts Institute of Technology. Basically, the main reasons for wanting to improve automatic process control are two: The need to improve product quality; and the need to make processes more fully automatic. These needs exist to a large extent because presently used control criteria are usually related only indirectly to the actual dynamics of the process, and to quality factors in the product.

As Brown and Campbell state, "Close control of physical variables does not necessarily guarantee minimum contamination or minimum imperfection of the product because 'degree of perfection' is not the quantity being measured to control the process." In the language of the servomechanisms specialist, there is no "feedback" of degree-of-perfection, which is "outside the loop."

A schematic suggestion of the way to bring quality control back "within the loop" appears in Fig. 14 where some variable related closely to product quality, such as viscosity, is measured and returned to the control circuit. Or the quality measure might be color or mass or infrared spectra. In a process where the control variables might be temperature, pressure and ratio of materials, as shown, and where the uncontrollable variable of raw materials properties also existed, there would seem to be no simple way to tie in viscosity. That is where the computer is likely to come in, since it will doubtless be needed to interpret the quality measure in the light of the process dynamics, and in turn to establish regulation over the various control variables.

There are many corollary aspects to the question of improving process control, most of them pointing to the eventual use of specialized computers as controller elements. Nobody is ready to predict when this will come about, but it is hardly likely to be many years in the future.

WHERE COMPUTERS ARE HEADED

We have already put it down as our belief that automatic computers are going to become important to chemical engineers and the chemical process industries. Having gone that far in prediction, what trends do we foresee for computers themselves?

The big, high-speed, general purpose machines may be approaching fairly close to the saturation point in absolute numbers since not many organizations can either justify the $0.5 million or more that they cost, or can keep them busy effectively. For those that will be built the trend already indicates less size, less weight, fewer tubes, and yet more capability. Where the really striking spread of computer application will probably take place will be in smaller, general-purpose, digital machines, and in special-purpose, high-speed digital and analog computers for simulation and instrument type uses. Engineers developed these smaller automatic computers. We believe they are going to discover them, as well.

In acknowledgement, we wish to thank the several members of the computer industry who rendered much assistance, particularly International Business Machines Corp., Remington Rand Co., and Eckert-Mauchly Computer Corp.

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Kinetics of Nitration

An explanation of the theory of the mechanism of nitration reactions. New light on a valuable tool for the process engineer and a clarification of some important industrial concepts.

W. R. TOMLINSON, JR. and P. H. GROGGINS

When dealing with nitration, an awareness of kinetics can make the chemical process engineer a better engineer. Why? Because it gives him valuable information—information regarding the right proportions of reactants, the best conditions for the highest yields of acceptable product and the basis to soundly evaluate any particular nitration from a cost standpoint.

A knowledge of kinetics also improves safety conditions by permitting the choice of mild but industrially useful conditions. Choosing the right catalysts, properly controlling a given process, watching out for exothermic oxidation—all these things are keyed to the science of kinetics. For example, during nitration, reduction products of nitric acid, nitrogen oxides and nitrous acid are formed. Such compounds are apparently converted to nitro compounds via nitrosation followed by oxidation. Knowing this, the controller can see to it that all acids for such nitrations contain a definite quantity of nitrous acid. Otherwise, use of acids containing no nitrogen oxides might easily lead to "fume off" when their gradual accumulation up to a threshold value, is followed by uncontrolled reaction because temperatures were too high or cooling and agitation inadequate.

RECENT DEVELOPMENTS

The mechanism of nitration reactions, the cornerstone of the explosives industry, have not until recently been well understood. Only lately researchers have learned that nitric acid behaves as a base toward sulphuric acid. That means that the most important reactions of this class, those conducted in a mixture of these two acids, can be more carefully controlled. In strong sulphuric, nitric acid ionizes according to the equation:

$$O_2N{-}OH + 2H_2SO_4 \rightleftharpoons NO_2^+ + H_3O^+ + 2HSO_4^- \qquad (1)$$

This reaction yielding the nitryl (NO_2^+) ion, presumably takes place through the protonation of nitric acid.

$$HO{-}NO_2 + H^+ \rightleftharpoons \left[\begin{matrix}HO\\HO\end{matrix}{>}N{=}O\right]^+ \xrightarrow{\text{slow}} H_2O + NO_2^+ \qquad (2)$$

This indicates the basic nature, relative to H_2SO_4, of HNO_3 which is, of course, an aquo acid. In this light it might be interesting to look at the functions of a dehydrant. It does not accelerate the nitration by extracting water from the reactants. Phosphorus pentoxide, for instance, although a very powerful dehydrant, does not raise the rate constant of a single phase mixed acid nitration. The dehydrant operates by reacting with the water formed in the nitration to yield protophylic (proton attracting) agents which accelerate the nitration. Other functions of a dehydrant are:

1. It maintains a system of proper acidity that will inhibit dissociation of nitric acid into H^+ and NO_3^- ions.
2. Dehydrants are relatively strong acids and will preferentially react with any water, free or liberated, to provide oxonium ions which may lead to the formation of nitryl ions by protonation of nitric acid.
3. In the presence of strong acids, such as sulphuric acid and boron trifluoride, nitric acid is basic and reacts to produce nitryl ions.
4. The dehydrant plays a most important role by providing protophylic ions which participate in the reaction by forming ionized complexes with NO_2^+, the organic compound, or both. By increasing the concentration of the trimolar activated complex it increases the reaction rate.
5. A dehydrant, such as sulphuric acid (a) provides solubility effects which accelerate the reaction; (b) moderates or controls the exothermicity of the reaction thus permitting safer operations; and (c) serves to inhibit the formation of oxidative byproducts.

In a noteworthy investigation of the kinetics of nitration of 2:4 dinitrotoluene (DNT), researchers, (Bennett et al, *J. Chem. Soc.*, 1946, 585, 869, 880), have demonstrated its mechanism and indicated the significance of the species involved in Eq. (1). The rates of nitration in mixed acid, they observed, conformed at constant sulphuric acid content to the usual bimolecular rate equation.

$$\frac{d[TNT]}{dt} = k'[DNT][HNO_3] \qquad (3)$$

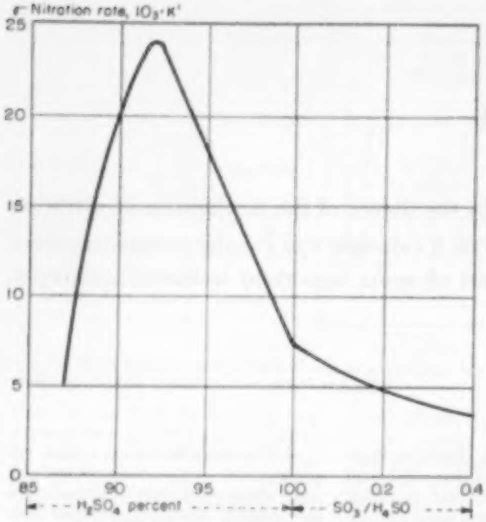
This equation which ignores Eq. (1) and the nitryl ion, does not anticipate any effect due to changes in the sulphuric acid concentration. Careful study of Eq. (1) along with a similar ionization in pyrosulphuric acid did permit the specification of k′ in terms of the chemical species involved. Thus,

$$k' = \left\{k_1[HSO_4^-] + k_2[H_2SO_4] + k_3[HS_2O_7^-]\right\}\frac{[NO_2^+]}{[HNO_3]} \qquad (4)$$

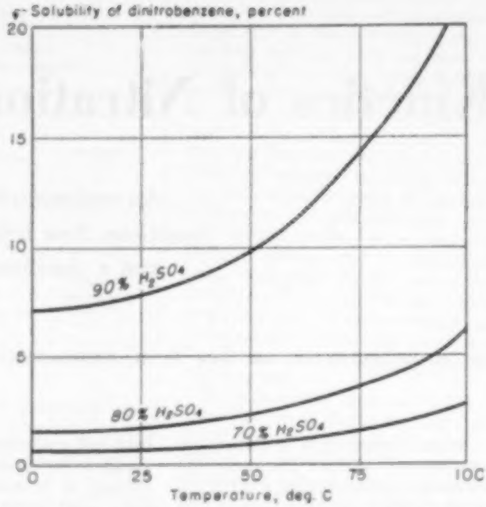
and Eq. 4 may be written

$$\frac{d[TNT]}{dt} = \left\{k_1[HSO_4^-] + k_2[H_2SO_4] + k_3[HS_2O_7^-]\right\} \times [DNT][NO_2^+]\,10^{-5} = k[DNT][NO_2^+]\,10^{-5} \qquad (5)$$

W. R. TOMLINSON, JR. of the Picatinny Arsenal, Dover, New Jersey and P. H. GROGGINS of the U. S. Dept. of Agriculture collaborated in this adaptation from the forthcoming 1951 edition of Dr. Groggins' book, "Unit Processes in Organic Syntheses."



1 Rate change between **roughly 90 and either** 87 or 100 percent sulphuric justifies attention to protophylic substances.



2 Enhanced solubility of nitro-compounds in sulphuric acid makes it necessary to operate in more concentrated acid.

where HNO_3, the total nitric acid content, includes $[NO_2^+]$. At 90 deg. C, k_1, k_2 and k_3 were found to be 3.3, 3.7 and 5.6 respectively, and k was maximized at 90 percent sulphuric acid. Fig. 1 shows the plot of k' versus H_2SO_4 at this temperature.

Eq. (5) is significant. It illustrates clearly that the mechanism of the nitration can be described sensibly in terms of (NO_2^+), but not (HNO_3). It also designates three protophylic entities, HSO_4^-, H_2SO_4, $HS_2O_7^-$, as participants in this reaction. The nitryl ion, in this case, is clearly the active nitrating agent.

So important is the concentration of sulphuric acid that there is a five-fold rate change between roughly 90 and either 87 or 100 percent sulphuric acid content, (see Fig. 1).

The above is somewhat oversimplified for, although the graph proves a clear cut case for 90 percent sulphuric acid content, the figure is slightly higher for large scale plant nitrations. Explanation follows this logic: (1) large amounts of nitric acid and nitratable materials lower the acidity value; and (2) the enhanced solubility of these nitro-compounds also weakens the acid. Therefore it is necessary to operate in more concentrated sulphuric acid than would be necessary merely to obtain the maximum rate constant.

The increase in solubility with rise of temperature and decrease with dilution of sulphuric acid is shown in Fig. 2 for dinitrobenzene. The effect this enhanced solubility in concentrated sulphuric acid has on the speed of dinitration of nitrobenzene is shown by the curves in Fig. 3. Here the fractional consumption of nitric acid plotted against the reaction time is shown.

Still another consideration is this: although the tests above were conducted in homogeneous systems (fundamental to kinetic studies) our interest is in the multicomponent systems used in industry. Here's how the two differ:

First, once the reaction rate has reached the maximum at 90 percent sulphuric, there's no dropping off, as shown in Fig. 1, when the water content is reduced to zero. Explanation is simple: (1) solubility of nitro compounds increases rapidly with sulphuric acid concentration and (2) increasing nitric acid content in very strong sulphuric acid leads to increasing nitryl ion content. (Fig. 4.) Each of these trends to preclude any diminution in the reaction rate. On the water side of the maximum the graph is true. Addition of water, bisulphite ion or any other diluent decreases the reaction rate.

Second, agitation is an important factor of the rate in two-phase nitrations. The trick is to keep each phase saturated with the other. This is done by emulsification with benzene.

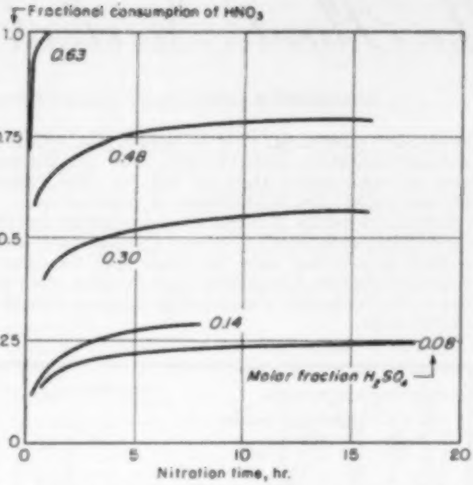
DVS AND NITRIC RATIO

The empirical concept *DVS* called dehydrating value of sulphuric acid has been successfully used in industrial nitrations for many years. The quantity is defined as the actual sulphuric acid content of the mixed acid divided by the water content of the spent acid. N_R (nitric ratio) as used industrially, is defined as: N_R = (lb. HNO_3) used)/(lb. mat. nitrated). This is proportional to the ratio of nitric acid used and that theoretically required. Thus, it is of obvious significance. By dividing N_R into the percent sulphuric acid in the mixed acid used, we get the weight of material to be added per 100 lb. of mixed acid. Thus *DVS* is in a sense a function of N_R and through *DVS*, N_R controls the amount of water present at the end of the reaction.

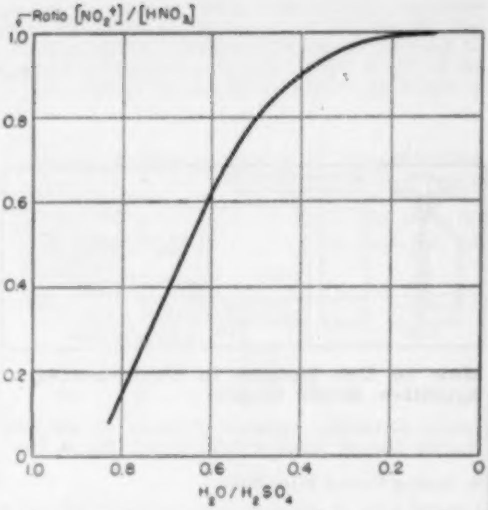
$$DVS = \frac{S}{\frac{N}{N_R} \; W \text{ (Water of Reaction)}} \quad (6)$$

Where: S = actual percent H_2SO_4 in the mixed acid; N = actual percent HNO_3 in the mixed acid; W = percent H_2O in the mixed acid (may be negative); "Water of Reaction" is that liberated in the reaction plus any originally present in the material nitrated. At a given temperature for a given N_R, yield is a function of *DVS*. The industrial chemist calculates the optimum *DVS* and N_R at a given date, considering the prices of all the ingredients and the yield.

The need for this concept, or one similar to it is especially clear if we recognize that it represents a convenient and efficient guide for con-



3 The effect of enhanced solubility in concentrated sulphuric on the speed of dinitration of nitrobenzene.



4 Constant decrease in k from 90 to 100 percent sulphuric acid takes place concurrently with rising nitryl ion.

trolling operations based on sound preliminary research, and, if we visualize practical operations, the works chemist has a mixed acid of known composition. The plant has facilities of known capacity and operations geared to batches that give desired productivity. The *DVS-N*, tool provides a simple method for process control and is related to the optimum combination of (NO_2^+) with (HSO_4^-) (protophylic ion) at the end of the nitration. Its specification assures that the reaction is completed at a practical rate, and fortunately all nitrations to which it has been applied proceed at useful rates from start to finish. This is undoubtedly due to the decrease in (NO_2^+) and increase in (HSO_4^-) throughout the reaction. Because the dehydrant plays several contributory roles in promoting the nitration reaction, it may be enlightening to interpret *DVS* as the driving value of sulphuric acid.

If one converts all the figures in a *DVS* calculation to mol percentages, the result will be the molar relation of water to sulphuric acid at the termination of reaction. Strangely enough, this residual acid strength approximates closely the minimum strength of sulphuric acid needed for the sulphonation of the organic compound. Since it is known that the nitryl ion can displace aromatically bound sulphonic acid groups, this relationship tends to confirm the belief that the dehydrant plays a most important role in some nitrations by providing protophylic ions. Considering Eq. (1) and $H_2SO_4 + H_2O = H_3O^+ + HSO_4^-$ it is found that

$$[NO_2^+][HSO_4^-] = K\,[HO\text{-}NO_2]\frac{[H_2SO_4]}{[HSO_4^-]}\,\frac{[H_2SO_4]}{[H_3O^+]} \quad (7)$$

The term on the left of (7) is the most important of the rate equation. Up to water contents of about 15 percent, water in sulphuric acid is completely protonated. Thus the factors $[H_2SO_4]/[H_3O^+]$ and $[H_2SO_4]/[HSO_4^-]$ are substantially equal to each other and to $[H_2SO_4]/[H_2O]$ where in the last factor H_2O refers to total mols of water present in the spent acid. *DVS* is, of course, proportional to this factor. Thus Eq. (7) may be written

$$[NO_2^+][HSO_4^-] = K'\,[HO\text{-}NO_2]\,(DVS)^2 \quad (8)$$

Further, $[HNO_3] \cong [HO\text{-}NO_2]$ in the spent acid, due to the amount of water present and its protonation by H_2SO_4. Eq. (8), or *DVS*, properly chosen, assures a practical rate at the close of the nitration, while this is assured throughout the process by the increase in $[HSO_4^-]$ as $[NO_2^+]$ decreases. In the light of this reaction the success of the *DVS* concept is not surprising.

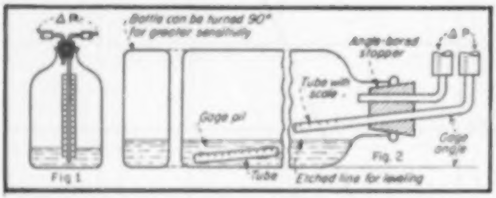
LIMITATIONS OF KINETICS

The utility of kinetic concepts in process control is limited, but this fact should not be disconcerting. There are no universal laws, rules or methods. Experience teaches that tools apply particularly to the field for which they were developed, but not to infinite extensions of the field. Thus the basic kinetic concept of medium constancy, which usually means dilute solution of the reactants, may place a limit on the accuracy of the results. For instance Eq. (4) gives a three component expression for k. It is quite likely that since H_2SO_4 is involved in k, where highly un-ionized nitric acid concentrations are considered, the value $(HO\text{-}NO_2 = (HNO_3) - (NO_2))$ should also appear since nitric acid provides more protophylic agents than sulphuric acid. Such changes on passing from dilute to concentrated solution may sometimes be determined or estimated.

In the reported kinetic study on the nitration of DNT a single phase system was employed while industrial processes generally involve a two-phase system. As the latter systems are diffusion controlled, obviously a quantitative rate value could not be obtained from Eq. (5). On the other hand, study of two phase systems shows that they behave qualitatively like the single systems on the water side of the maximum. Although this prevents accurate *a priori* calculation of the optimum conditions, the understanding of the reaction mechanism and of the reason for the differences in behavior of one and two phase systems is a real aid in planning the development study of the practical process.

The Plant Notebook

THEODORE R. OLIVE, *Senior Associate Editor*



How to Use Bottles in Constructing Sensitive Draft Gages

LESLIE SILVERMAN, *Associate Professor of Industrial Hygiene, Harvard School of Public Health, Boston, Mass.*

★ **October Contest Prize Winner**

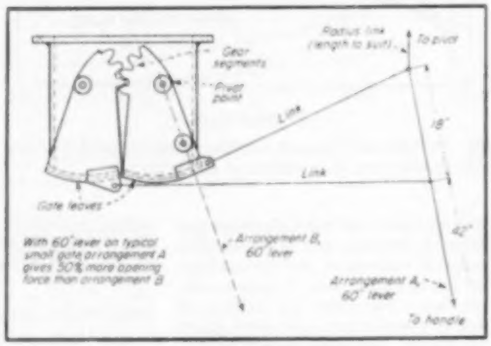
Bottle gages of the type shown in Fig. 1 are useful devices for measuring pressure differentials with any gage fluid, but ordinarily are limited to pressures not less than 0.2 in. of water. They are portable and can be used as absolute or differential gages. The range and application of such a device can be greatly extended by the use of rectangular or square bottles as shown in Fig. 2. By use of this type of bottle, inclined gages can be constructed which are inexpensive, provide their own leveling device and have negligible scale correction because of the large cross-sectional area of the well.

Gage inclination can be controlled by bottle size. Capacities of 1, 2, 4, 8, 16 and 32 liquid ounces are readily obtained. Roux culture bottles (1,000 ml.) with offset necks are useful for large sizes. A wide range of angles can be obtained by utilizing different sizes of pharmaceutical bottles.

Provision of a scale for reading the gage can be accomplished by several methods. A simple procedure is to use a small plastic ruler held by rubber bands (Fig. 1), or to etch a scale on a piece of glass tubing (Fig. 2). Another useful scale can be obtained by using a broken Mohr pipette (1 ml. divided into hundredths) and providing a conversion table based on linear distance between markings. The angle is easily determined from the bottle and stopper dimensions.

It can be noted that this rectangular bottle gage can be used as a vertical gage or as an inclined gage with two angles of inclination. Small size units (1 to 2-oz. bottles) serve as useful pocket gages for field use. Soft rubber stoppers provide ease in adjustment of positional use.

Leveling is evident by ruling a line for position around the periphery of the bottle as shown. This provides an easy method of indicating when the bottle is in the correct horizontal position. For absolute gages the glass tube can rest on the bottle neck with the angle measured from the contact point.



How to Get More Leverage On Duplex Bin Gates

CHESMAN A. LEE, *Engineer, Evanston, Ill.*

Duplex gates on the outlets of bins for storage of solids ordinarily consist of a square body with two "leaves" geared together as the sketch shows. Usually one leaf is operated directly by a lever of convenient length, attached as shown in Arrangement *B*. This means that the only force on the other leaf is the tooth load on the tooth segment, acting at a radius which is limited to half the center distance between the leaf pivots. Friction makes the situation worse.

In handling crushed stone, clay and similar materials it is often desirable to have more leverage. Larger gate

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★ **NOVEMBER PRIZE WINNER—A $50 prize will be issued to . . .**

ROMAN C. BIEBER
Instrument Engineer, Lonza Ltd.
Visp, Switzerland.

. . . for an article describing a method of controlling the flow of a suspension at small variable flow rates, such that the valve cannot clog. The method is especially suitable for handling catalysts. Winner of our November Plant Notebook contest, it will be published in January.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook.

The winner each month will be announced in the issue of the next month, e.g., the December winner will be announced in January and his article published in February. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at space rates.

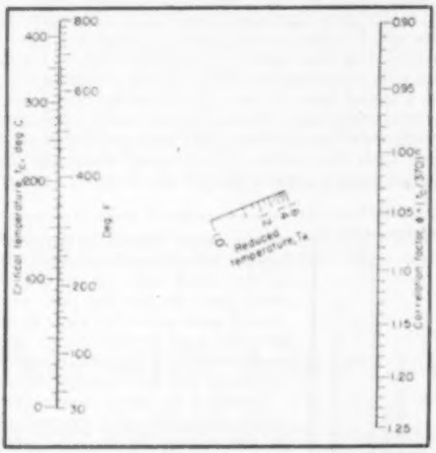
HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible.

Articles may deal with any sort of plant or production "kink" or short-cut that will be of interest to chemical engineers or others in the process industries. Also, novel means of presenting useful data, as well as new cost-cutting ideas are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

sizes sometimes secure this by omitting the gear arrangement and using bar links to a lever on an independent fulcrum. This reduces friction and also gives greater leverage. A convenient scheme for small gates (which generally use the gear segments) is one that I worked out 20 years or so ago. Perhaps this principle has been used in the years since I left the materials handling game but, if so, I have not seen it applied.

The scheme is easily added to existing gates as in Arrangement A. The idea is to provide a floating fulcrum to allow for the lack of symmetry in mounting. The gear segments still transmit some moment but their main job is to synchronize and centralize the gate leaves. Calculations of moments for a typical small gate with approximately a 15½-in. leaf radius show that a 10-lb. pull on a 60-in. lever will give a 30-lb. opening force on each leaf with Arrangement A, but only a 20-lb. force with Arrangement B.

Actually, guides for the lever are needed. Also, design will hinge on the actual situation, and some improvization may be needed.



Nomograph Gives Enthalpy Correction For Non-Ideal Gases

Dale S. Davis, *Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.*

Although the enthalpy of an ideal gas is independent of pressure, such is not the case for an actual gas, especially near the critical point. Correction of enthalpy for nonideality may be made by means of plots[2,3,4] of $(H^* - H)/T_c$ as ordinate, against P_R as abscissa for various values of T_R, where H^* and H = enthalpies of ideal and actual gases, respectively, in gram calories per gram mole; P_R = reduced pressure; and T_R = reduced temperature.

For values of T_R between 1.0 and 1.6, York and Weber[4] suggested that the ordinates of these plots should be multiplied by a correlation factor ϕ, defined as $(T_c/370)^n$, where T_c = critical temperature of the gas, deg. K.; 370 = critical temperature of propane, deg. K.; and n depends on the reduced temperature of the gas as follows:

T_R	1.00	1.05	1.10	1.20	1.30	1.40	1.50	1.60
n	0.37	0.28	0.25	0.20	0.18	0.16	0.15	0.14

The accompanying nomograph, constructed by methods previously described,[1] permits rapid and accurate calculation of the correlation factor. The use of the chart is illustrated as follows: What is the enthalpy correlation factor for butane at 243 deg. C. or 516 deg. K? The critical temperature of butane is 218 deg. C. or 491 deg. K. Connect 218 on the t_c scale with 516/491 or 1.05 on the T_R scale and read the correlation factor on the ϕ scale as 1.085.

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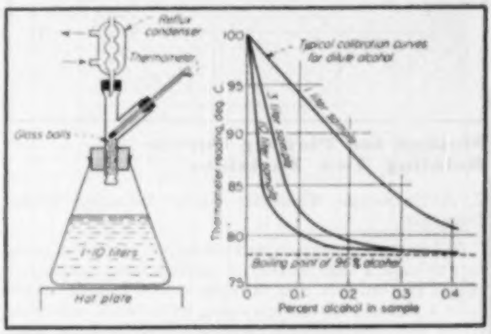


Plant Test for Dilute Volatiles In Still Bottoms

Richard H. Westergaard, *Northern Regional Research Laboratory U. S. Department of Agriculture, Peoria, Ill.*

While technical manager of Algea Produkter A/s, Kristiandsund, N. Norway, the writer developed a simple test for the concentration of volatiles such as ethyl alcohol in dilute solutions. Developed and used as a plant control test for determining the amount of alcohol in the waste liquor leaving the bottom of a distillation column, the method is well adapted for plant use since it can be run successfully by unskilled workers. The equipment is inexpensive, requiring nothing but a few pieces of laboratory glassware and a heat source which can be relied on to give a constant rate of heat output. An ordinary electric hot-plate serves well for the purpose.

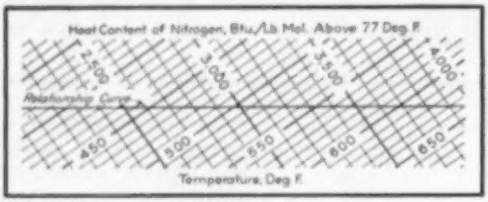
The apparatus works as a rectification column with total reflux. The distillate collects in the distillation head itself, which contains a 40 mm. filling of 4 mm. glass balls. If the amount of alcohol present in the sample is too great (over a few tenths of 1 percent), this "distillate" will be close to 96 percent alcohol, and the thermometer will show the boiling point of that strength. But if the quantity of alcohol is sufficiently small, practically all of it will gather in the distillation head and still be more or less diluted with water. The boiling point of the "distillate" is read on the thermometer. If a 3-liter sample is used, it takes approximately 15 minutes before the thermometer reading comes to rest.

For a sample of a given size, the correlation between this thermometer reading and the concentration of alcohol in the sample can be determined experimentally by using water with a known amount of alcohol added. As noted the heat supply must be constant, since the amount of distillate which can stay on the column filling will be larger if more heat is used. If no constant heat supply is available, the number of drops leaving the condenser in a

given time can be used to adjust the heat supply to the fixed value.

The method is very sensitive; 0.01 percent alcohol gives a reading of 98 deg. C. with a 3-liter sample. Furthermore, the presence of large amounts of non-volatile compounds does not impair it. It is suitable only for the determination of rather small concentrations of alcohol, but the range can be adjusted by choosing a sample of the proper size, or by diluting it to within the proper range.

The method can undoubtedly be used for other systems.



Method for Plotting Curves Relating Two Variables

Z. A. Stanfield, *Tennessee Valley Authority, Wilson Dam, Ala.*

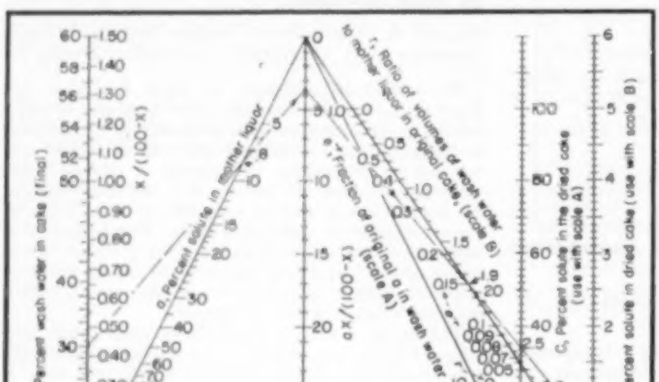
When making engineering calculations, it is often necessary to make a large number of readings from a curve that relates two variables. For example, in heat balance calculations a plot of heat content versus temperature is familiar. These data commonly are presented in tabular form which usually requires interpolation; if a plot is desired, it is necessary to use large sheets of graph paper, which are inconvenient to handle and read.

A convenient method for plotting heat content versus temperature is shown in the accompanying graph. The values, shown for nitrogen, were converted to engineering units from data in "Selected Values of Chemical Thermodynamic Properties," published on March 31, 1947 by the National Bureau of Standards.

It has been found that by this method data can be plotted and read more quickly than by conventional methods. For example, the heat content of nitrogen at 450 deg. F. is 2,617 Btu. per pound-mol., which is found at the intersection of the temperature coordinate with the relationship curve.

Better Way to Prevent Freezing Of Outdoor Water Pipes

Engineers of Ebasco Services have worked out a method for electrical heating that has been used to prevent freezing of water piping serving a semi-outdoor power plant. The pipe is first given a standard double layer of hot-pipe insulation which is then covered with aluminum foil taped on. An electric heating cable is either wound around the insulated pipe or secured parallel to it, and the cable covered with a second layer of foil to distribute the heat produced by the heating cable. The second foil layer is covered with three layers of ⅛-in. asbestos roll board and the whole protected from the weather by corrugated aluminum sheets wrapped around. Heat is needed only in severe weather.



Nomograph for Washing of Cakes on Filters

B. H. Nicolaisen and T. M. Jenney, *Development Dept., Mathieson Chemical Corp., Niagara Falls, N. Y.*

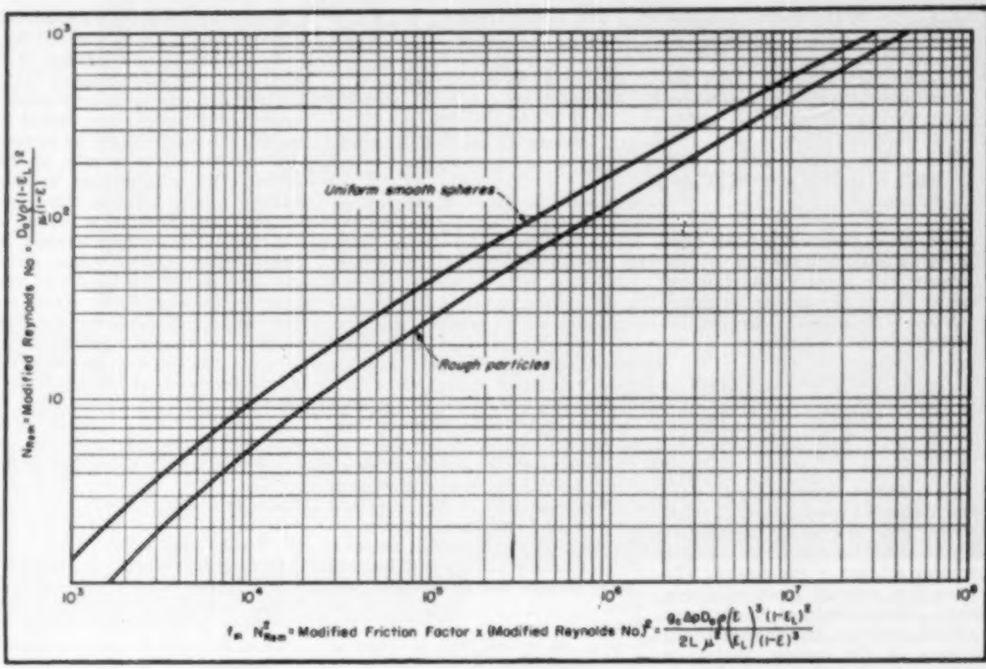
How much wash water must be used to achieve a desired purity of filter cake in washing it on the filter is a problem that has troubled many development workers. The authors have attacked this problem mathematically and from this work have developed the accompanying nomograph. It permits the washing requirements to be determined quickly if the percent wash water in the final cake, percent solute in the mother liquor, and allowable percent solute in the dried cake are known. The chart gives directly the ratio of volume of wash water that must be used, to volume of mother liquor in the original cake. It also shows the solute remaining and the washing efficiency.

Letting c = percent solute allowed in the dried cake; a = percent solute in the mother liquor; x = percent wash water in the final cake; r = (volume of wash water used)/(volume of mother liquor in the original cake); and e^{-r} = fraction of original a in the wash water, then the relations have been found to be represented by the equation:

$$c = a\left(\frac{x}{100-x}\right)e^{-r}$$

The nomograph solves this equation. As an example of its use, let $c = 0.5$ percent, $a = 8.0$ percent, and $x = 30.0$ percent. Enter the chart at $x = 30.0$ and connect with $a = 8.0$, extending the line to the central scale. Connect this intersection with $c = 0.5$, intersecting the r scale at $r = 1.9$, showing that 1.9 volumes of wash water must be used for each volume of mother liquor in the original cake. The lefthand scale of the r line shows $e^{-r} = 0.15$, which is the fraction of original solute in original mother liquor remaining. Hence $1 - e^{-r} = 1 - 0.15 = 0.85$, and the washing efficiency is 85 percent.

As proof of the accuracy of the method, the average of 11 actual determinations from cakes 2 in. thick checked within 10 percent of the values predicted.



This chart correlates the relationship between pressure drop, fluid velocity, particle size, void volume, degree of compactness, etc., for any bed consisting of regular shaped particles such as cylindrical pellets, spherical balls, and granules (Raschig rings not included).

Versatile Chart Aids Δp Calculations

This chart eliminates trial and error when approach velocity is the unknown (Example 1), permits calculations on fixed beds of widely-varying particle sizes (Example 2), takes into account increase in bed density due to vibrational compacting and formation of fines (best shown in Examples 1 and 2), and ties together data on fixed and moving beds (Example 3).

JOHN HAPPEL AND NORMAN EPSTEIN

Example 1: What is the allowable air velocity through this preheater?

An air preheater of the regenerative type employs spherical alumina pellets 0.30 in. diam. as the heating medium. Air passes upward through the bed and is preheated to 1000 deg. F. The problem is to fix the air flow so that the pressure gradient is only 80 percent of that required to make the bed boil or lift.

JOHN HAPPEL is chairman of the department of chemical engineering at New York University, where NORMAN EPSTEIN is a graduate doctorate student and part-time instructor. A paper describing the correlation upon which this article is based was recently presented by Professor Happel to the North Jersey Section, American Institute of Chemical Engineers.

(1) If the bed is initially in the loose packed condition, what will be the allowable mass velocity of air? In the loose packed condition the bulk density of the bed is 90 lb./cu. ft. and the fractional void volume is 0.47.

(2) In the course of time the bed becomes compacted, due to vibration, so that its fractional void volume is 0.40. Compute the allowable mass velocity of air under these conditions.

Solution

(1) Allowable $\Delta p/L = 90 \times 0.80 =$ 72 lb./sq. ft./ft.

ρ at 1,000 deg. F. = (29/359) (492/1460) = 0.0272 lb./cu. ft.

μ at 1,000 deg. F. = $0.036 \times 0.000672 = 2.42 \times 10^{-5}$ lb./ft. sec.

$D_p^3 = (0.3/12)^3 = 1.563 \times 10^{-5}$ ft.

$\varepsilon = \varepsilon_L = 0.47$

Substituting in the chart equation:

$f_m N_{Re,m}^2 = 32.2 \times 72 \times 1.563 \times 10^{-5} \times 0.0272/2 \times (2.42)^2 \times 10^{-10} \times 0.53 = 1.587 \times 10^6$

From the curve for rough particles:

$N_{Re,m} = 149 = D_p G(1-\varepsilon)/\mu$

$G = 149 \times 2.42 \times 10^{-5}/0.025 \times 0.53 = 0.272$ lb. air/ft.^{2}/sec.

(2) Allowable $\Delta p/L = 72 \times 0.60/0.53 = 81.5$ lb./sq. ft./ft.

Substituting in the chart equation:

$f_m N_{Re_m}^2 = 32.2 \times 81.5 \times 1.563 \times 10^{-4} \times 0.0272 \times (0.40)^2 \times (0.53)^2/2 \times (2.42)^2 \times 10^{-10} \times (0.47)^2 \times (0.60)^2 = 7.64 \times 10^4$

From the curve for rough particles:

$N_{Re_m} = 96 = D_s G(1 - \epsilon_L)^2/\mu(1 - \epsilon)$

$G = 96 \times 2.42 \times 10^{-4} \times 0.6/0.025 \times (0.53)^2 = 0.198$ lb. air/ft.^{2}/sec.

Example 2: How will pressure drop through a random mixture of catalyst compare with pressure drop through separate layers of screened fractions?

A fine granular catalyst has the following Tyler screen analysis:

Mesh	Openings, Mm.	Retained, % by Wt.
14	1.168	....
20	0.833	7.2
28	0.589	67.4
32	0.495	21.0
35	0.417	4.4

Compare the pressure drop for fluid flow through a given weight of catalyst in "random loose" arrangement in a tube of fixed diameter: (1) using a random mixture of the catalyst; (2) using four separate layers of closely sized, screened fractions. In the loose packed condition the fractional void volume of the random mixture is 0.49, while that of each of the uniformly sized layers is 0.54. For purposes of comparison assume air at 70 deg. F. and atmospheric pressure as the fluid, with a mass velocity of 0.1 lb./(sec.)(ft.^{2}).

Solution

$\rho = 29 \times 492/359 \times 530 = 0.0750$ lb./cu. ft.

$\mu = 0.0177 \times 0.000672 = 1.19 \times 10^{-5}$ lb. /(ft.) (sec.)

(1) $\epsilon = \epsilon_L = 0.49$

From the screen analysis, using arithmetic averages of screen diameters:

$D_s = 100/(7.2/1{,}000 + 67.4/0.711 + 21.0/0.542 + 4.4/0.456) = 0.666$ mm. $= 0.00218$ ft.

Substituting in the chart equation:

$N_{Re_m} = 0.00218 \times 0.1 \times 0.51/1.19 \times 10^{-5} = 9.35$

From the curve for rough particles:

$f_m N_{Re_m}^2 = 1.98 \times 10^4 = g_c \Delta p D_s^3 \rho/2L\mu^2(1 - \epsilon)$

$f_m N_{Re_m}^2/D_s^3 = 1.98 \times 10^4/(0.00218)^3 = 1.91 \times 10^{12} = g_c \Delta p_r \rho/2L_r \mu^2(1 - \epsilon_r)$

(2) $\epsilon = \epsilon_L = 0.54$

Using the same procedure as in (1), the following tabulated values are obtained for each layer:

W	D_s, Ft.	N_{Re_m}	$f_m N_{Re_m}^2$	$\frac{W f_m N_{Re_m}^2}{100 D_s^3}$
7.2	0.003275	12.66	3.02×10^4	0.000618×10^{12}
67.4	0.00233	9.01	1.80×10^4	1.008×10^{12}
21.0	0.001777	6.87	1.31×10^4	0.490×10^{12}
4.4	0.001496	5.79	1.06×10^4	0.1391×10^{12}
				1.635×10^{12}

$1.635 \times 10^{12} = g_c \Delta p_s \rho/2L_s \mu^2(1 - \epsilon_s)$

For equal weights of catalyst:

$L_r(1 - \epsilon_r) = L_s(1 - \epsilon_s)$

Hence $\Delta p_s/\Delta p_r = 1.635 \times 10^{12}/1.91 \times 10^{12} = 0.856$

$\therefore$ Decrease in Δp due to screening $= 14.4$ percent.

Example 3: How will the pressure drop through a moving bed in this butane dehydrogenator compare with the pressure drop through a fixed bed?

N-butane is to be dehygrogenated in the vapor phase by passing it continuously over a granular catalyst at 1100 deg. F. and atmospheric pressure. Compare the pressure drop for equal weights of catalyst in (1) a moving bed reactor and (2) a fixed bed of equal diameter, assuming "random dense" packing in the latter case. The rough catalyst granules are 3/16 in. diam., and the fractional void volumes are 0.52 and 0.43 in the loose and dense packed conditions respectively. For purposes of comparison, assume a vapor approach velocity of 1 fps. and ignore changes due to chemical reaction.

Solution

$\rho = 58 \times 492/359 \times 1560 = 0.0509$ lb./cu.ft.

$\mu = 0.021 \times 0.000672 = 1.41 \times 10^{-5}$ lb./ft. sec.

$D_s = 3/16 \times 12 = 0.0156$ ft.

(1) $\epsilon = \epsilon_L = 0.52$

Substituting in the chart equation:

$N_{Re_m} = 0.0156 \times 1 \times 0.0509 \times (0.48)^2/1.41 \times 10^{-5} \times 0.48 = 27.0$

From the curve for rough particles:

$f_m N_{Re_m}^2 = 9.6 \times 10^4$

Substituting in the chart equation:

$\Delta p_1/L_1 = 9.6 \times 10^4 \times 2 \times (1.41 \times 10^{-5})^2 \times 0.48/32.2 \times (0.0156)^3 \times 0.0509 = 2.94$ lb./ft.^{2}/ft.

(2) $\epsilon = 0.43$, $\epsilon_L = 0.52$

Substituting in the chart equation:

$N_{Re_m} = 0.0156 \times 1 \times 0.0509 \times (0.48)^2/1.41 \times 10^{-5} \times 0.57 = 22.8$

From the curve for rough particles:

$f_m N_{Re_m}^2 = 7.3 \times 10^4$

Substituting in the chart equation:

$\Delta p_2/L_2 = [7.3 \times 10^4 \times 2 \times (1.4 \times 10^{-5})^2/32.2 \times (0.0156)^3 \times 0.0509] \times (0.52/0.43)^2 \times (0.57/0.48)^2 = 6.62$ lb./ft.^{2}/ft.

For equal weights of catalyst:

$L_1(1 - 0.52) = L_2(1 - 0.43)$

Hence $L_2/L_1 = 0.48/0.57$

$\therefore \Delta p_2/\Delta p_1 = (6.62/2.94) \times (0.48/0.57) = 1.895$

Example 4: Smaller catalyst is to be used to speed up reaction. How much will this increase the pressure drop?

A hydrolysis reaction is carried out in dilute aqueous solution at 100 deg. F. by circulating the solution at a mass velocity of 15 lb./(min.) (ft.^{2}) over uniform smooth balls of densely packed metal catalyst. It is desired to increase the reaction rate by increasing the surface/volume ratio of the catalyst. This will be done by substituting 2 mm. balls for the 1 cm. balls currently being used. What is the expected percentage increase in pressure drop? The random dense and loose packed fractional void volumes for uniform smooth spheres are 0.38 and 0.47 respectively. The density and viscosity of the dilute aqueous solution may be taken as that of pure water at 100 deg. F.

Solution

ρ at 100 deg. F. $= 62.0$ lb./cu.ft.

μ at 100 deg. F. $= 0.684 \times 0.000672 = 4.60 \times 10^{-4}$ lb./ft. sec.

$\epsilon = 0.38$

$\epsilon_L = 0.47$

(1) For the 1 cm. balls:

$D_s = (1/254)(1/12) = 0.03275$

Substituting in the chart equation:

$N_{Re_m} = (0.03275)(15/60)(0.53)^2/(4.60 \times 10^{-4})(0.62) = 8.06$

From the curve for uniform smooth spheres:

$f_m N_{Re_m}^2 = 7.7 \times 10^4$

(2) For the 2 mm. balls:

$D_s = 2/25.4 \times 1/12 = 0.00655$

Substituting in the chart equation:

$N_{Re_m} = (0.00655)(15/60)(0.53)^2/(4.60 \times 10^{-4}) \times (0.62) = 1.1612$

From the curve for uniform smooth spheres:

$f_m N_{Re_m}^2 = 1.2 \times 10^4$

$(1.2 \times 10^4)/(7.7 \times 10^4) = \Delta p_s D_{s2}^3/\Delta p_1 D_{s1}^3$

Hence $\Delta p_2/\Delta p_1 = (1.2/7.7)(10/2)^3 = 19.5$

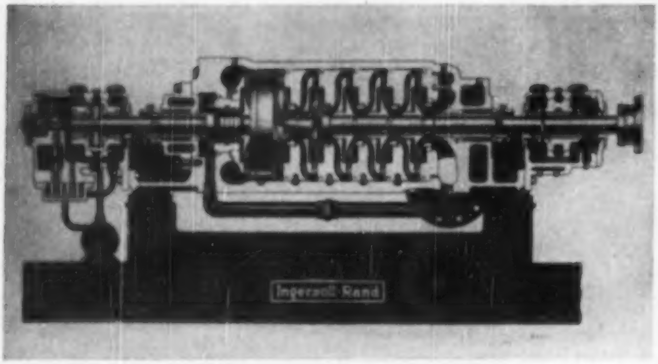
$\therefore$ Increase in $\Delta p = 1950$ percent.

NOMENCLATURE

- D_s — Average diameter of particles in a bed by reciprocal mean method, ft.
- f_m — Modified friction factor.
- G — Mass velocity of fluid, lb./(sec.)(ft.)^2
- g_c — Conversion factor in Newton law of motion, 32 2, (lb.) (ft.)/(sec.)^2.
- L — Length of bed, ft.
- N_{Re_m} — Modified Reynolds number.
- Δp — Pressure drop, lb. force/sq. ft.
- V — Approach velocity of fluid, ft./sec. For a bed, V is the superficial fluid velocity over the entire bed cross-section.
- W — Weight percentages of screened fractions of material W_1, W_2, etc. having average diameters of D_1, D_2, etc.
- ϵ — Fractional void volume in a granular bed.
- ϵ_L — Fractional void volume in the "loose-packed" condition.
- μ — Viscosity of fluid, lb./(sec.) (ft.).
- ρ — Density of fluid, lb./cu. ft..

Process Equipment News

THEODORE R. OLIVE, Senior Associate Editor



Multi-Stage Centrifugal Pumps Developed For High Pressures and Temperatures

High efficiency is claimed for new line of pumps built in four sizes to 6 in., and in three to nine stages.

(*140A*) Latest development of the Ingersoll-Rand Co. in the handling of liquids is the new Class HMTA multi-stage centrifugal pump which is built in pipe sizes of 3, 4, 5 and 6 in., and in from three to nine stages for handling pressures to 1,200 psi. These pumps are designed to operate at temperatures up to 650 deg. F., and capacities ranging from 125 to 1,600 gpm. A similar series of pumps, intended to operate at 50 cycles in similar ratings, is given the designation of Class HMTB. These pumps have been designed to meet the widest possible range of applications, including high-pressure refinery service, high-pressure chemical plant use, boiler feed service, and hydraulic de-barking of logs.

An outstanding feature of the new design is the fact that the entire rotor assembly is installed as a unit and is similarly removable from the pump casing. The latter is horizontally split and has a completely smooth inner bore, free from the usual cast volute passages. The rotor assembly consists of a shaft carrying a separate assembly for each stage. A stage assembly includes a multiple volute or diffuser, an impeller, and various wearing rings, positioning rings, spacer sleeves, and a hydraulic type piston ring which snaps into a machined groove in the diffuser housing or channel ring and provides effective interstage sealing. Except for the inlet and outlet stages, all stage units are alike and completely interchangeable.

To take care of high-temperature operation, the pump is provided with water-cooled stuffing boxes, supplied either with packing or with a rotary seal, depending on the type of service. To take care of hydraulic unbalance, the pump employs a simple hydraulic balancing drum. Either anti-friction or sleeve bearings can be provided. If the latter are chosen, the outboard bearing is of the Kingsbury thrust type with its own forced lubrication system. Sleeve bearings are of the spherical, self-aligning type, while in the anti-friction type, a spring mounting is provided to allow for endwise shaft motion due to the action of the balancing drum during starting or stopping. For high-temperature operation, above 250 deg. F., provision is made for longitudinal expansion of the pump on its base plate. Other special features include positive lubrication and the availability of a special smothering gland for use where volatile liquids are handled. These various features are claimed to give high sustained efficiency, greater dependability, and less maintenance in severe service.

PROVIDES MULTIPLE PROTECTION:

Carbon Dioxide System

(*140B*) By the proper use of directional valves, Walter Kidde & Co. is now installing built-in carbon dioxide fire extinguishing systems which can protect as many as 25 hazardous areas with only a single bank of carbon dioxide storage cylinders manifolded together for simultaneous discharge. The way this works is this: From a manifold connected to the bank of carbon dioxide cylinders, separate lines run to each area to be protected. Each such zone has its own discharge nozzles and fire detectors. A directional valve controls each separate line. When a fire detector picks up the first signal of fire in any hazard area, it actuates one of the directional valves controlling the group of cylinders. Or in some cases, the cylinder bank can be arranged in groups so that each of several hazards can be protected by an initial discharge group controlled by a mechanical linkage between the directional valve and the cylinders in that particular group. A reserve supply in this case is also available.

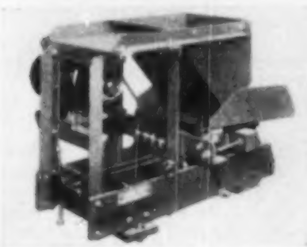
OPERATES ELECTRONICALLY:

Temperature Instruments

(*140C*) As another application of its Microsen balance principle, Manning, Maxwell & Moore, Inc., has announced a line of thermocouple-actuated temperature indicators and recorders suitable for the range from −100 to +3,000 deg. F. These in-

struments use the Microsen electromechanical balance system for balancing a force proportional to the thermocouple input against another force proportional to the mechanical position of the instrument pointer. In this way, the instrument gets away from the need for slide wires, standard cells, and delicate parts or complicated mechanisms.

Both indicating and recording instruments employ a pointer (or pen) which is driven by a powerful rotary solenoid. Instruments are said to be accurate within one-half of 1 percent of the scale range, regardless of normal temperature or supply voltage variations. They incorporate automatic cold junction compensation which is accomplished by placing the cold junction in a small insulated and heated chamber which remains at constant temperature under thermostatic control for large ambient temperature variations.



WIDE DELIVERY RANGE:

Vibratory Feeder

(*141A*) Known as the Velosifter, a new vibratory feeder operating on a mechanical vibrating principle, has been introduced by the English firm of Henry Simon, Ltd. The feed trough is mounted on legs, enabling it to oscillate with an inclined motion at frequencies up to 1,850 oscillations per minute. The drive is accomplished through a rotating unbalanced weight assembly which drives the trough forward by impact through a rubber pad. Feed rate can be adjusted from zero to 100 percent in an infinite number of steps by varying the distance between the vibrating drive system and the trough. This is quickly accomplished by means of a handwheel. The effect of this construction is said to give tremendous capacity for the power consumed, a 1/10-hp. motor being sufficient to drive a trough 12 in. in width which may have a capacity anywhere from a few ounces per hour to 15 or more tons. The new construction is also said to balance out unwanted vibrations and to result in extremely quiet operation, with uniform delivery rate. It is claimed further that any kind of crushed material, damp or dry, seems to work satisfactorily, and that even feathers have been handled, moving through a pipe instead of a trough.

USES STEEL EFFICIENTLY:

Sedimentation Tank

(*141B*) In order to make more efficient use of the strength of the steel used in construction of its sedimentation tanks for hot-process water softeners, Graver Water Conditioning Co. has developed a novel shape of steel tank combining a hemispherical top and a conical bottom. In the customary cylindrical shape, consisting of a dished top cylindrical tank with a conical bottom, to meet the need for the largest possible settling area for the treated water requires a heavily built and strongly reinforced tank. In the new design, the Graver Sphericone, the hemispherical top provides the natural strength superiority which is inherent in its shape as compared to a cylinder. Raw water, steam, chemical inlets, spray heater, deaerator, and treated water collector are all mounted in the hemisphere. In the inverted conical section are the downtake, sludge bed and rising zone of the water being treated. Several of the new tanks have already been purchased, including one for 600,000 lb. per hr. of treated water, said to be the largest hot-process, hot-zeolite water softener in existence.

CLASSIFIES PARTICLES:

Fly Ash Collector

(*141C*) A new development of Prat-Daniel Corp., now offered by the Thermix Corp., is a tubular dust collector which classifies the products collected into two fractions. The primary purpose is to separate high-carbon particles leaving powdered-coal-fired boiler furnaces from the incombustible fly ash, thus enabling

(*Continued*)

New This Month . . .

More Information . . .

To learn more about any item described here, circle the item number on the Reader Service Postcard inside the back cover.

Marshall and Stevens Indexes of Comparative Equipment Costs

(1926 = 100)

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, Feb. 1950, p. 123.

	Sept. 1949	June 1950	Sept. 1950
Industry			
Average of all	159.6	163.1	171.5
Process Industries			
Cement mfg.	155.9	158.1	163.4
Chemical	162.4	166.1	171.4
Clay products	150.4	153.1	158.4
Glass mfr.	153.5	156.2	161.5
Paint mfr.	156.7	159.4	164.7
Paper mfr.	157.0	159.7	165.0
Petroleum ind.	159.8	162.5	167.8
Rubber ind.	162.2	164.9	170.2
Process ind. avg.	160.9	163.5	168.9
Related Industries			
Elec. power equip.	165.0	167.7	173.0
Mining, milling	164.1	166.8	172.1
Refrigerating	173.9	179.4	180.8
Steam power	152.1	154.8	160.1

the combustible material to be returned to the boiler. This separation is accomplished on one pass through the collector. Two hoppers are provided, one to collect the larger particles suitable for refiring. The other collects the low-carbon particles for disposal. The new method, known as PD decantation, is said not to affect the normal resistance of the dust collector unit.

IMPROVED DESIGN AVAILABLE:

Self-Sluicing Filter

(*142A*) Several design improvements have been made in the Auto-Sluice pressure leaf filter originally announced two years ago. According to Niagara Filter Corp., the special filter cover containing the sluicing mechanism has been modified so that it can now replace the standard non-sluicing cover on older Niagara filters. Thus any large Niagara filter now in use can be made automatically self-sluicing. Other improvements include modified air motors to operate the sluicing sprays which require substantially less maintenance than in older models; a simplified linkage between the air-motor piston and the sluicing spray header; and a new, specially developed stuffing box packing which permits leak-free filtration of corrosive and sticky liquids under pressure differentials as high as 65 psi.

In this design a header in the filter cover contains high-pressure spray nozzles. When the cake is to be sluiced from the leaves, an air motor imparts both rotary and reciprocating motion to the header, enabling a minimum of sluicing liquid to clean all filter surfaces. This arrangement is said to remove as much as 35 cu. ft. of filter cake in as little as 15 min. with only 70 to 100 cu. ft. of sluice water. Since the cake does not have to be handled at all, it is possible for the operator to take care of other tasks while the filter is sluicing. Auto-Sluice filters are available in sizes from 120 to 750 sq. ft. of filter area, in any suitable construction material.

PACKAGED TYPE:

Atmospheric Cooling Tower

(*142B*) Designated as Type H is a new small atmospheric spray type cooling tower made by the Binks Mfg. Co. This unit is intended primarily for water-cooled air-conditioning and refrigeration condensing units and is produced in ten frame sizes for refrigeration loads from 3 to 35 tons. Among its features are the following: The pan is made with external bolting flanges for convenient and firm anchoring to the tower. Newly designed corner posts bolt easily and rigidly to the pan sides. Louvers, either of redwood or galvanized steel, slide into place through machine-slotted corner posts at accurate spacing and angle. The float box is an integral part of the basin and is mounted externally for easy access to the control valve.

HANDLES SMALL FLOWS:

Dry Chemical Feeder

(*142C*) Supplementing its line of gravimetric dry chemical feeders, Omega Machine Co. has introduced a midget machine known as Model 50-8. The new machine has an 8-in belt with a 1-ft. weigh span and a capacity of 3 cu. ft. per min. Claimed for it are high accuracy, a feeding range of 100 to 1, positive non-flooding characteristics, and the use of stainless steel in contact with the material handled. The feeder is driven by a single ¼-hp. motor and has hopper agitation proportional to the feed rate, an automatic alarm device, and a stainless steel enclosure.

REDUCES MAINTENANCE:

Electronic Timer

(*142D*) Designated as Model CK, a new electronic timer announced by Farmer Electric Co. employs a cold-cathode trigger tube and so overcomes the need for frequent tube replacement. Since the tube requires no filament current, there is no wear on the tube during standby periods and timing is said to be instant and accurate without warm-up. A further advantage is that the timer can recycle immediately without the necessity to recharge a timing condenser between cycles. The timer is built in four ranges from 1½ to 12 sec., with a dial graduated in 100 parts to allow the timer to be set to any desired percentage of the total range. It operates on 105-125 v., 60 cycles a.c., and handles 8 amp. non-inductive load at 125 v. a.c. on the control relay.

MEASURES SPEED RATIOS:

Electric Stretch Meter

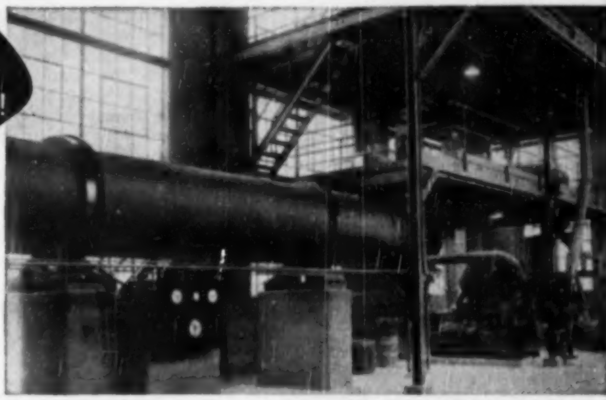
(*142E*) Newest of the Tag-Weston industrial instruments produced by Tagliabue Instruments Division is a meter that measures percentage of stretch or shrinkage of materials being processed over pairs of rolls. The instrument operates by measuring the speed ratios of selected rolls over which the material travels. The ratio can then be recorded on the instrument chart in terms of per-

(*Continued*)

See Louisville for CREATIVE DRYING ENGINEERING

Resin Producer Ends Contamination—Speeds Drying —Saves $40,000 A Year with Louisville Dryer

KNOW THE RESULTS before you buy!



FORMER DRYER

Installed cost $32,000
Drying time .... 300 minutes
Drying cost .... $1.42 per 100 lb.
(space required, 2,000 sq. ft.)

LOUISVILLE DRYER

Installed cost $78,000
Drying time .... 25 minutes
Drying cost .... $0.415 per 100 lb.
(space required, 900 sq. ft.)

YEARLY SAVINGS OF LOUISVILLE DRYER IN OPERATING COSTS ALONE . . . $40,000

Sometimes the cheapest drying methods are the most expensive!

Take the case of this producer of synthetic resin for plastics. His situation was studied by a Louisville engineer who uncovered this fact: by investing *more* money in a Louisville Dryer—especially designed for the job—savings would more than write off the cost of the new equipment in less than 2 years. In addition, total enclosure of the material to be dried would mean no contamination from airborne dust, dirt. Speeded-up drying time improved product quality.

Tests in our own research laboratories and pilot plant predetermined the performance of this custom-built dryer. Have a Louisville engineer survey your drying methods. No obligation. Write today.

Ask for new treatise on subject of rotary dryers

Other General American Equipment:
Turbo-Mixers, Evaporators, Thickeners, Dewaterers, Towers, Tanks, Bins, Filters, Pressure Vessels

GENERAL AMERICAN

Louisville Drying Machinery Unit

Over 50 years of creative drying engineering

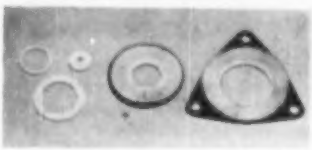
GENERAL AMERICAN TRANSPORTATION CORPORATION

Dryer Sales Office: Hoffman Bldg., 139 So. Fourth Street
Louisville 2, Kentucky
General Offices: 135 South La Salle Street, Chicago 90, Illinois
Offices in all principal cities

centage shrink or stretch, or other desired units. Applications for the new instrument lie in such fields as paper, plastics and rubber.

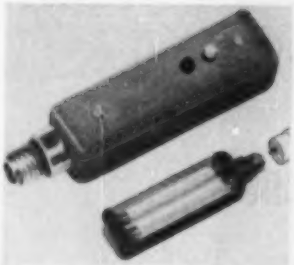
HIGH AIR CAPACITY:
Electric Air Heaters

(*144A*) By assembling individual Chromalox Finstrip electric heaters in banks to form sections of various sizes which are welded into one large frame for mounting in air ducts, the Edwin L. Wiegand Co. has developed a line of electric heaters for large air volumes. These are intended both for comfort and process heating. The heaters have Monel sheaths and fins, while all metal parts of the frame are given a rustproofing and are coated with baked on heat-resistant enamel. The unit shown is rated at 440 v., 192 kw. It consists of four separate, removable quadrants of 48 kw. each. The heater can be wired for infinite control to as low as 10 percent of full rated capacity.



MADE IN MANY TYPES:
Teflon Gaskets

(*144B*) Under the trade name of Korda, Chicago Gasket Co. has introduced an extensive new line of Teflon gaskets. These are resistant to practically all chemicals, except molten sodium and fluorine at elevated temperatures and pressures. The new gaskets are being fabricated in many different forms including both solid and Teflon-jacketed types. The jacketed type employs a seamless, one-piece, precision-machined jacket of pure Teflon, with a heavier wall of Teflon on the inside diameter. These are produced in several grades for pipe sizes from ¼ to 6 in., inclusive.

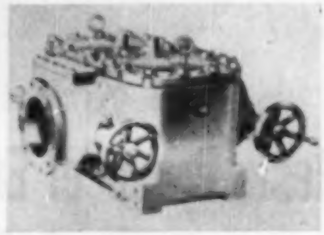


SCREW-IN BULB:
Miniature Fluorescent

(*144C*) For providing comparatively small quantities of fluorescent lighting with the convenience of the ordinary screw-in incandescent bulb, Stocker and Yale has developed the Lite-Mite fluorescent "bulb" which contains two 4-watt fluorescent lamps and all control components, entirely within a 2-in. x 6-in. shade. The combination has a screw base and operates in any ordinary light socket. It is said to produce four times as much light for the same wattage as an incandescent bulb. Neither the lamp nor the shade ever get hot, but the combination is said to produce up to 500 foot-candles at 3 to 5 in. working distance. Average life is claimed to be 7,500 hr., or in normal service about 3½ years between lamp replacements.

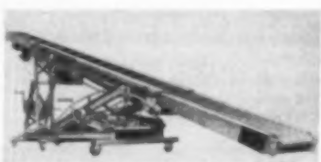
REDUCES TURBULENCE:
High-Pressure Gasket

(*144D*) To streamline the path of fluid flowing in a pipe as it passes through a flanged joint, Flexitallic Gasket Co. has developed a new high-pressure gasket which streamlines the jointed connection, reducing turbulence in the pipe, and increasing the flow correspondingly. The new gasket, designated as Style CGI, is a compression gage type with both an inside and outside ring. It has a spiral-wound construction with alternating and V-crimped plies of metal and filler. It is claimed that for all practical purposes the inside ring converts one of a pair of smooth-face flanges to a grooved flange, providing the safety of a wholly contained gasket without the expense of machining the flange. The inside ring is said not only to reduce turbulence, but to prevent radial movement of the gasket under extremely high bolt loads, and to minimize gasket contamination from highly corrosive fluids. The new gasket is available in pressure ranges from 150 to 2,500 psi., for practically all standard ASA and API fittings, as well as special designs. Available construction materials for the inside ring include stainless steels as well as other alloys such as Monel, nickel, or Inconel. A wide choice of filler materials, including Teflon, is available.



LOW PRESSURE DROP:
Duplex Strainer

(*144E*) Use of special angle design applied to the multiple catch baskets, so as to permit straight-through flow, is responsible for the low pressure drop claimed for a new gate-type duplex strainer produced by J. A. Zurn Mfg. Co. It is claimed that with the baskets 90 percent blocked, the pressure drop increases only 44 percent as measured with water at room temperature. The strainers are fitted with hinged top covers and multiple strainer baskets to allow cleaning by one man. The baskets are designed for complete retention of strained particles during removal for cleaning. These strainers are made in seven sizes from 8 to 24 in. in diameter, for handling flow rates from 400 to 15,000 gpm.



ADDS TO ITS LENGTH:
Adjustable Conveyor

(*144F*) An adjustable-angle belt conveyor of the portable type, which is also adjustable in length by almost 100 percent, has been developed by the Stewart-Glapat Corp. The new Adjustoveyor is actually a standard length unit and an extreme length unit combined. In addition, it is capable of assuming ten different positions. The unit can always be adjusted to the length desired within its maximum and minimum limits. By means of the withdrawing boom, the

(Continued)

Chemical and Physical Properties of Fused Alumina Filter Plates

Norton Alundum* porous plates, unaffected by acid, neutral and slightly alkaline liquors, combine uniform porosity with great strength.

Made of fused alumina, fired to at least cone 12, Norton Alundum porous plates are relatively unaffected by acid, neutral and slightly alkaline liquors. The high alumina glass bond may be affected by strong and hot sodium and potassium hydroxides and by hydrofluoric acid. The following table shows the results of solubility tests under exacting conditions with standard 12" x 12" x 1" Norton Alundum porous plates.

SOLUBILITY TESTS

Solution	Strength in Percent	Percent, Cumulative Loss — Same Plate Alternating Hot and Cold: Loss at 10 Days (75 Hrs. at 85-100° C. 169 Hrs. at 20° C.)	Loss at 20 Days (131 Hrs. at 85-100° C. 349 Hrs. at 20° C.)	Loss at 30 Days (192 Hrs. at 85-100° C. 528 Hrs. at 20° C.)
Phosphoric Acid	85.00	.373	.522	.654
Phosphoric Acid	42.50	.290	.362	.394
Sulphuric Acid	96.00	.326	.444	.488
Sulphuric Acid	25.00	.391	.494	.578
Nitric Acid	70.00	.149	.187	.232
Nitric Acid	22.00	.130	.167	.234
Hydrochloric Acid	35.00	.354	.528	.674
Hydrochloric Acid	20.00	.292	.352	.397
Hydrofluoric Acid	.25	.602	.644	.644
Sulphuric Acid	1/5 of 96.00			
Nitric Acid	1/20 of 70.00	.188	.318	.388
Ammon. Hydroxide	28.00	at 20°C. .046	at 20°C. .057	at 20°C. .062
Sodium Hydroxide	10.00	.937	1.453	2.302
Calcium Hydroxide	Sat. Sol.	at 20°C. .032	at 20°C. .046	at 20°C. .062
Ammonium Chloride	10.00	.041	.053	.076
Zinc Chloride	10.00	.084	.123	.142
Zinc Chloride	5.00	.032	.044	.052

NOTE { Only in the case of sodium hydroxide were edges of plates affected. A slight rounding was noticeable as was to be expected.

UNIFORM PERMEABILITY

Because of Norton's patented "Controlled Structure" process, Alundum porous plates meet extremely rigid specifications for uniform permeability. The size and number of open pores determine permeability. The following table gives approximate pore sizes for different porosities and permeabilities. Permeability is given in cubic feet of air passed per minute on a dry plate 12" x 12" x 1" under 2" water pressure.

Permeability	Percent of Pore Space by Volume	Avg. Dia. of Pores
4 cubic feet	36	0.09 mm.
20 cubic feet	35	0.21 mm.
40 cubic feet	34	0.30 mm.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

GREAT STRENGTH

The following table of tests on standard Alundum 12" x 12" x 1" porous plates of various permeabilities indicates the ability of these plates to operate under high pressures and to resist breakage and chipping due to handling and cleaning.

Average Permeability of Dry Plate, cu ft/min/sq ft/in. thick./at 2 in. Water Pressure	Average Modulus of Rupture, psi: Dry	Wet	Breaking Load when Wet Plate is Supported on Four Sides with ½" Bearing: Ft. of Water	#/sq. in.
121.0	1670	1465	97	42
80.9	1950	1685	110	48
37.8	2684	2235	147	64
16.9	3045	2644	175	76
4.1	3770	3716	246	107

GET BULLETIN 140

All of the foregoing data, as well as detailed installation and cleaning instructions, are contained in a highly informative 16 page bulletin. To get it, contact your nearby Norton representative or write direct. **NORTON COMPANY, 501 NEW BOND ST., WORCESTER 6, MASS.**

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

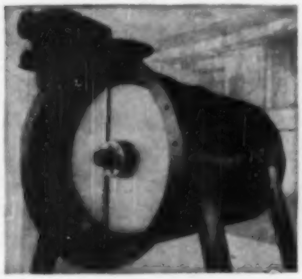
Canadian Representative
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

conveyor can go over aisleways, and yet permit passage of other equipment as the boom is controlled by separate power. This gives rapid opening and closing without interfering with material being carried on the conveyor. The conveyor is made in both slide and roll types, the former being capable of handling 850 lb. distributed, or a net unit load of 150 lb. The roller type will handle proportionately heavier loads. The conveyor is made in five sizes, the smallest 8 ft. long closed and 14½ ft. open, the largest 32 ft. closed and 55½ ft. open.

SOLVES DRYING PROBLEMS:

New Pilot Dryer

(146A) To assist in determining the design requirements for production models of Standard-Hersey dryers, the Dryer Division of Standard Steel Corp. has developed a pilot dryer so constructed that with minor adjustments the performance of any type rotary dryer can be simulated with reasonable exactness. This is an actual dryer, scaled down, and mounted so that the pitch can be varied from zero to 1 in. per foot. Speed of shell rotation and feed are fully adjustable and the dryer can be hooked up for any type of operation, including concurrent, countercurrent, or intermediate feed. Interchangeable dust collectors of four types, including cyclones, air washers, filters, and electrostatic precipitators, can be used on either the inlet or discharge ends. All parts contacting the drying gases and products are of stainless steel and the shell is completely insulated to permit accurate heat balances. Interchangeable heating elements provide for temperatures up to 1,800 deg. F., or even higher. The dryer is equipped with all necessary instruments for determining air and fuel requirements, retention time, pertinent temperatures, moisture content, and other variables.



CLEANS ITSELF:

Pressure-Disk Filter

(146B) Sparkler Mfg. Co. has recently developed the Model SC series of self-cleaning pressure-disk filters. A simple mechanical arrangement is used to secure positive cleaning action whenever desired. This consists in having nylon brushes set between the unit's circular filter disks, with the ends of the brushes connected to a revolving brush cage extending the length of the filter. When the filter requires cleaning, water is flushed through to the outlet drain while the cage revolves either by hand or by power. Thus, the brushes sweep both sides of the disks, and solids drop to the bottom of the filter and are washed through the outlet drain. In many applications, it is claimed, complete cleaning can be accomplished in only 2 to 5 min. It is also possible to use a backwash operation in conjunction with the brushes, requiring very little clean backwash water.

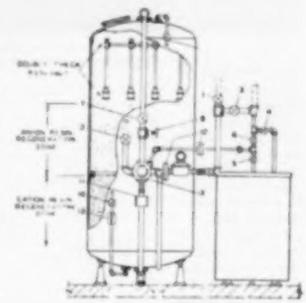
EASY TO CHANGE

(146C) Some models of the Clark Equipment Co.'s industrial fork trucks are now being equipped with demountable cushion-style rubber tires which require even less time to mount than a passenger car tire. Others models of the company's trucks will be so equipped at a later time. The new tire has the advantages of the old cushion type which was pressed onto the wheel, but can be changed in 15 min., as contrasted with several hours required to remove and replace the usual pressed-on solid tire.

CUTS MAINTENANCE:

Floor Treatment

(146D) To facilitate cleaning of industrial floors and to prevent dusting, West Disinfecting Co. has developed Antiseptic Westone which is easily mopped on to the floor at the rate of 4,000 sq.ft. of floor surface per gallon. This treatment seals the floor, eliminates dusting and facilitates cleaning. Floor maintenance cost is said to be reduced to as much as 50 percent through its use. Furthermore, there is said to be less possibility of cross infection among plant personnel when dust is suppressed in this manner.



IMPROVED WATER QUALITY:

Mixed-Bed Deionizer

(146E) Lower investment, coupled with the ability to produce higher quality water, is claimed for the new mixed-bed deionizer offered by the Elgin Softener Corp. The mixed-bed deionizer requires only a single tank. The anion and cation resins are operated mixed together. At the end of the cycle, when the resins are exhausted and ready for regeneration, they are separated on the basis of density by being backwashed into two separate zones. This enables the two resins to be regenerated separately, the cation resin being regenerated by dilute sulphuric acid and the anion exchanger by a caustic solution. After regeneration, the resins are washed and then remixed by liquid flow and are ready for reuse.

Because of the ability of the process to remove silica and carbon dioxide from water, it is claimed that it is suitable for preparing feed for high-pressure boiler plants and other processes requiring highest quality water. Other advantages as compared with multiple-bed deionizers include reduction in cost, in time for regeneration, and in rinse water requirements. To enable the maximum amount of exchanger resins to be employed without

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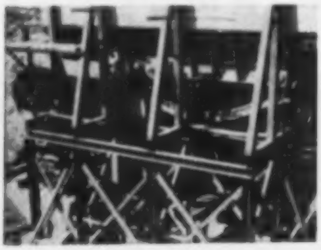
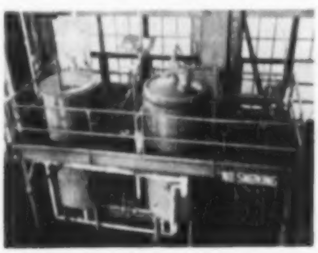
danger of loss, the new unit incorporates a double-check manifold arrangement in the upper part of the tank.



FOR HEAVY-DUTY SERVICE:

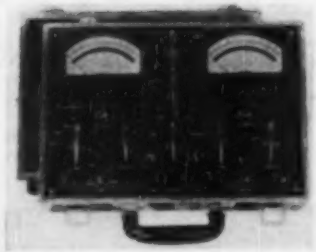
Manganese Apron Feeder

(148A) For extremely heavy-duty service, Lippmann Engineering Works has supplemented its line of heavy-duty apron feeders with a new manganese steel feeder having an apron width of 4 ft., and available in various lengths. The pans, rollers, sprockets and bushings are of cast austenic manganese steel. The frame is heavy structural steel, firmly welded and supported with cross structural members. All shafts turn on oversize anti-friction bearings, and the cast manganese steel pans hinge together in an endless apron which is self-cleaning and firmly supported by ribbed members for the heaviest impact service. The particular feeder shown above is operating in a quarry and feeding rock to a 36 x 48-in. jaw crusher.



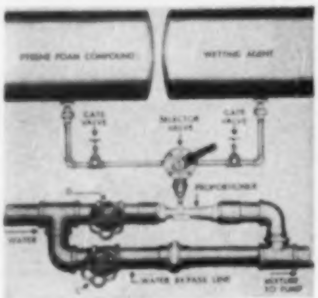
NEW IMPREGNATORS ANNOUNCED

(148B) Struthers-Wells Corp. is now building a standard line of impregnators for impregnating carbon parts, wood, and other materials. This equipment includes a quick-opening arrangement for the tank cover, allowing the cover to be opened or closed in a matter of seconds without manual effort. The equipment can be heated by steam, electricity, or Dowtherm, and is available in a complete range of sizes for vacuum and pressure operation.



CORROSION STUDY METER

(148C) Known as Model B-2, a new meter for the study of electrolysis, corrosion and cathodic protection is being offered by M. C. Miller. With a single instrument it is claimed that practically all measurements involved in these studies can be made, either in field or laboratory. The instrument incorporates two high sensitivity d.c. instruments which can be connected into a variety of measuring circuits.

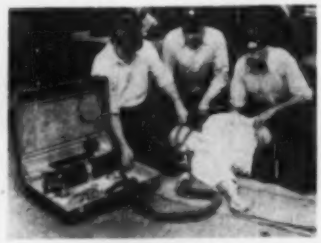


AIDS FIRE FIGHTING:

Selector Valve

(148D) With the advent of wetting agents to improve fire fighting in certain types of applications, it becomes possible to fight more kinds of fire effectively with water and certain additives. Pyrene Mfg. Co. has developed a selector valve for use on fire apparatus, fire-fighting trailers and stationary installations, which enables an immediate choice to be made between the addition of foam compound, or of wetting agent, to the water. The new selector valve has four positions, enabling a 1 or 2 percent proportion of wetting agent to be used, or a 5 percent concentration of foam compounds. The fourth position is "off."

A 1 percent concentration of wetting agent is used on Class A fires in wood, paper, and the like, whereas a 2 percent concentration is used for Class B fires in flammable liquids where the product is of a heavy base. Water containing wetting agents is most commonly used with fog nozzles. The 5 percent mixture of foam compound in water, producing approximately 350 gal. of foam for every 20 gal. of water and 1 gal. of compound, is used primarily for flammable liquid fires.



FOR ASPHYXIATION VICTIMS:

Automatic Breather

(148E) A device for performing artificial respiration automatically on victims of drowning, asphyxiation, poisonous gases, or electric shock has been brought out by Mine Safety Appliances Co. Called the Pneolator, the device is said to be more efficient than the manual method of artificial respiration. However, until it is possible to start the automatic machine, manual artificial respiration should be carried out.

The device consists of a rubber and plastic face piece connected to two valves by corrugated rubber tubing. One of the valves administers oxygen with a positive pressure at regular intervals, cycling automatically. The other valve lets oxygen flow only when the patient inhales, stopping the flow

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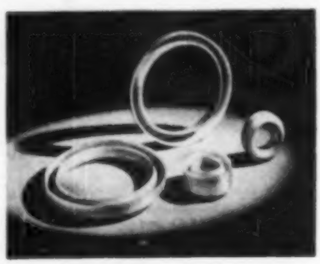
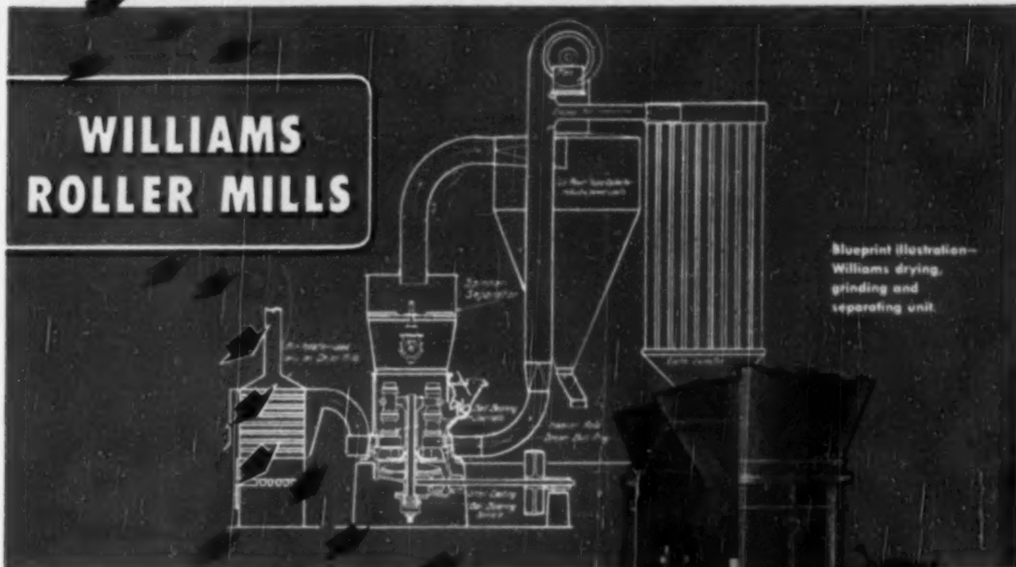


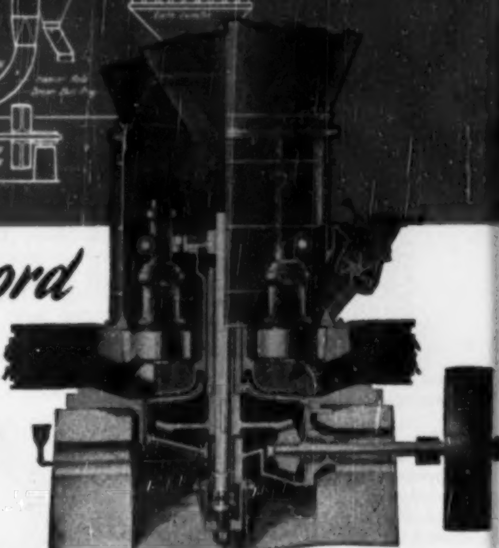
TEFLON V-RINGS

(148F) For use as a valve rod packing and in slow-speed reciprocating pumps, the Teflon Products Division of United States Gasket Co. has developed a V-type Teflon packing known as Chemiseal No. 810V. The design, coupled with Teflon's natural slipperiness, greatly reduces the gland loading needed and the torque necessary to operate the valve. The rings may be split for assembly, if necessary, without harming the packing.

For those Fine Grinding Jobs . . .



let's look at the record



Sectional view of Roller Mill showing how material is ground between rolls and bull ring, then air swept to Separator which extracts fines and returns oversize for re-grinding.

PYRETHRUM AND OTHER FIBROUS INSECTICIDES

The Williams Roller Mill has given excellent results in the grinding of various rotenone bearing insecticides as it pulverizes the fibres to the same uniform fineness as the rest of the plant. Pyrethrum flowers can be pulverized to 98.5% passing 200 mesh. Also grinds D.D.T., Sodium Fluoride, etc.

PAINTS, PIGMENTS, DRY COLORS

Williams Roller Mills are establishing remarkable records in the grinding of pigments and dry colors to finenesses of 99.95% 325 mesh and finer. Fineness instantly changed by varying speed of Spinner Separator Blades.

FINE GRANULATIONS

Williams has developed a special type of impact pulverizer to operate in connection with the air separator for the making of fine granulations of 30 to 80 mesh with a minimum of fines.

BARYTES, PHOSPHATE, LIMESTONE

Almost any mineral can be economically pulverized with the Williams Roller Mill. Finenesses quickly changeable from 40 mesh to 400 mesh. All can be dried and ground simultaneously by introduction of hot air.

WILLIAMS ALSO MAKES . . .

Heavy-duty hammermills; impact and roller mills for 200 to 325 mesh grinding; drier mills; air separators; vibrating screens; steel bins; complete "packaged" crushing and grinding plants.

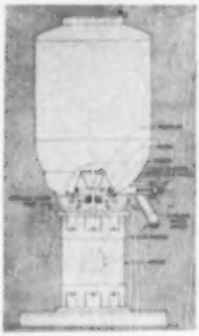
WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. NINTH STREET — ST. LOUIS 6, MO.

WC49-11

WILLIAMS

CRUSHERS — GRINDERS — SHREDDERS

on exhalation. The valves interchange automatically, depending on whether the victim is breathing. Oxygen is delivered automatically at a preset pressure to the victim's lungs. The machine does not suck air from the lungs, however, instead shutting off and letting the elastic walls of the lungs produce exhalation by natural recoil. If the victim is breathing, the inhalator demand valve automatically admits as much oxygen as he can inhale. The pressure used is fully adjustable to take care of individual requirements. Only a little instruction is necessary to enable anyone to operate the instrument.



SPEEDS MIXING AND GRINDING:

Dispersion Grinder

(150A) A new combination of mixing and grinding elements is incorporated in the so-called dynamic dispersion grinder produced by T. J. Laird Equipment Corp. This machine consists of a vessel, in the lower part of which is the Laird unit. The latter is water-jacketed and operates on the material in several successive actions. First, the top mixing propeller whirls the rough mixture violently and at high velocity toward the rotor. Second, the material is mechanically sheared by the rotor and stator. Third, it is hydraulically sheared by the centrifugal action of these two parts. Material being ground and mixed then leaves the chamber containing the grinding unit through radial slots at high velocity, scouring the sides of the mixing vessel as it returns to the mixing unit for successive passes.

Used initially in the paint industry, the new mixer-grinder would also seem to offer possibilities in colloidal dispersing. In one paint industry installation, a single machine producing 1,200 gal. of house paint is said to have displaced four pebble mills and three workmen working a 24-hr. cycle, completing the job with one grinder and one workman in an 8-hr. day. These machines range in size from 18 to 230 total working capacity gallons, consuming from 10 to 60 hp.

MODERNISTIC DESIGN:

Electrical Panel Instruments

(150B) Three different sizes are being produced in a line of modernistic panel instruments for electrical measurements by Simpson Electric Co. These instruments are made in sizes of 4½, 3½ and 2 in. width, all identical in design. They are provided with large, easy-to-read scales that are said to be highly visible under all light conditions. The instrument face is protected with unbreakable plastic. Vertical chrome-plated strips at the ends are recessed into the plastic, fluted cover.

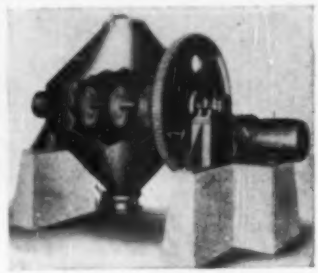
LATERAL PIPE CONNECTOR

(150C) To simplify making lateral pipe connections to branch and main pipelines, Smith-Blair, Inc., has introduced a single-strap clamp making use of special molded rubber and oil resistant gaskets to effect a leak-proof seal. The principal feature is a wedging action of the resilient gasket which develops partly from the hydraulic pressure within the pipe, with only moderate tightening of the strap nuts. Used originally on asbestos-cement pipe, the device is also being used on light-weight steel pipe.

REDUCES WATER DAMAGE:

Sprinkler Stopper

(150D) Because much water damage is done by sprinklers after the fire is out, interesting possibilities in damage reduction are offered by a new device made by the Sprinkler Stopper Co. This device, which is inserted into the sprinkler head by the fireman after the need for the water has passed, is a simple unit on the end of a short pole. It consists of a wedge with a three-layer rubber diaphragm which covers the outlet and maintains pressure on the sprinkler so as to stop the water flow. After use, the dangling pole serves as a reminder that the sprinkler is temporarily out of operation.



BREAKS UP AGGLOMERATES:

Disintegrating Blender

(150E) To produce successful blends from chemicals, pigments, resins and other materials containing small amounts of moisture which may form agglomerates during the mixing cycle, Patterson Foundry & Machine Co. has developed a disintegrating chemical blender. This machine is of the standard double-cone type except that it is equipped with disintegrating elements mounted on a shaft extending through the blender trunnion. These elements, rotating at high speed and in counter rotation to the blender proper, break up any agglomerates formed, but do not reduce particle size. Produced in both mild steel and special alloys, the new blender is made in operating capacities from 0.35 to 550 cu. ft.

FOR LOW-COST WATER:

Rechargeable Deionizer

(150F) To decrease the operating cost of making deionized water for users needing not more than 10 gph., Penfield Mfg. Co. has introduced a small mixed-bed unit with a reusable cartridge that is simply recharged with suitable cation-anion ex-

(Continued)

Drip Proof

Splash Proof

Totally Enclosed Fan Cooled

Explosion Proof

ALTERNATING CURRENT MOTORS

POLYPHASE

Squirrel Cage Induction — 1/6 to 400 H.P.
Wound Rotor Motors—1 to 400 H.P.
Synchronous Motors—20 to 150 H.P.

SINGLE PHASE

Split Phase Induction—1/6, 1/4, 1/3 H.P.
Capacitor—1/6 to 20 H.P.
Repulsion Start, Brush Lifting, Induction—1/2 to 20 H.P.

DIRECT CURRENT MOTORS

1/6 to 300 H.P.

GENERATORS

AC, .63 to 250 KVA
DC, .75 to 200 KW

GEAR MOTORS

1/8 to 1-1/2 H.P.

MOTOR GENERATOR SETS

AC to DC, AC to AC
DC to DC, DC to AC

Open Protected, Splash Proof, Totally Enclosed Fan Cooled, Explosion Proof.

Ball Bearing motors are factory lubricated for several years' normal service. Bearing housing construction permits easy re-lubrication when unusual service demands it.

CE-673

To guard your production against the destructive effects of atmospheric hazards, Century offers four types of protective motor frames.

DRIP PROOF—meets the requirements of most installations. Use it where operating conditions are relatively clean and dry. Top half of the frame is enclosed to keep out falling solids and dripping liquids.

SPLASH PROOF—keeps splashing liquids out of the motor even when the frame is washed with the full force of a hose. Use Century Splash Proof motors indoors or outdoors.

TOTALLY ENCLOSED FAN COOLED—resists the hazards of abnormal concentrations of dusts, powders, grit, oil mists, acid and alkali fumes.

EXPLOSION PROOF—protects life and property in atmospheres charged with explosive dusts or vapors.

The properly selected protection with the wide variation of starting torque characteristics to choose from provides long operating life and improves the production of the driven equipment.

Century motors are available in a wide range of kinds and types—in sizes from ½ to 400 horsepower—for single phase, polyphase and direct current applications.

Specify Century motors for all your electric power requirements.

CENTURY ELECTRIC CO. [illegible] Pine St. • St. Louis 3, Mo.

Offices and Stock Points in Principal Cities

changer resins when exhausted. The unit contains a built-in flow meter for optimum flow control, and a conductivity meter for determining when resins should be renewed.

COMPACT DESIGN:

Packless Solenoid Valves

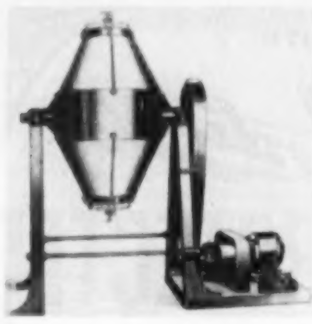
(152A) Two new valves have been added by the Automatic Switch Co. to its line of two-way and three-way packless solenoid valves. These are extremely small and compact. The two-way, normally closed type is made in [illegible]- and [illegible]-in. sizes, and the three-way and normally open valves are made only in the [illegible]-in. size. Both are produced either in brass or in stainless steel. They are capable of handling a wide range of liquids and gases at temperatures up to 212 deg. F., employing a flat, resilient synthetic composition disk said to be absolutely tight against either gas or liquid and resistant to many chemicals. All internal parts are readily accessible without removing the valve body from the line or disturbing electrical connections.

DESIGN SAVES ON COST:

Alloy Heat Exchanger

(152B) A new design of double pipe heat exchanger said to provide corrosion resistance at a fraction of the cost of convention alloy metal units is being offered by the Martin-Quaid Co. Known as the Econalloy heat exchanger, it achieves its economy through the use of corrosion-resisting materials only where they are needed. These uses include flange inserts which support the inner tube within the outer tube, and the inner tube itself, which conducts the corrosive vapor or liquid being heated. An important feature is the corrosion-resisting joint between tube and flange which is made without welding to the inner tube. The alloy inner tube is expanded into prepared serrations in the flange insert by special torque-limiting tools which prevent undesirable stresses.

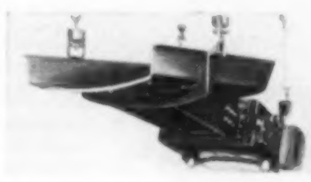
This design is said to provide uniform heat over the whole surface from flange to flange without dead spots. Heat exchangers are available in sizes from a fraction of a square foot of heating surface, to several hundred square feet, in lengths up to 30 ft. per segment. Internal tube sizes range from [illegible] to 4 in., for pressures up to 900 psi. and temperatures in excess of 700 deg. F.



SHELL MADE OF PORCELAIN:

Double-Cone Blender

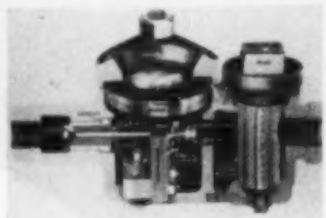
(152C) So that materials that cannot be handled in metal can be mixed by the double-cone blender method, Paul O. Abbé, Inc., has developed a machine of this type with a double cone portion consisting completely of porcelain, so that the materials handled do not contact metal at any point. The porcelain conical section holds 56 gal. Its inside diameter at the widest point is 24[illegible] in., and inside length 46[illegible] in.



DUST-TIGHT DESIGN:

Vibratory Feeders

(152D) For especially severe and dusty working conditions, the Syntron Co. has added to its standard line of heavy-duty Vibraflow vibratory feeders a dust-tight model in which the working parts are covered by gasket-sealed plates bolted to the magnet casting. These parts include the leaf springs, the armature, and the core. By enclosing these parts, protection is obtained against clogging by excessive supply hopper spillage or heavy dust conditions. The protective covering does not affect the capacity or feed rate of the conveyor.



ONLY ONE SIZE:

Universal Steam Trap

(152E) Developed and formerly used only abroad, the Velan steam trap has recently been introduced into this country by Velan Engineering Co. The trap operates in any position, incorporates a strainer and sight glass into the standard construction, and is said to have more capacity in the standard size with ½-in. orifice than other types of traps in pipe sizes up to 2 in.

The principle employed is quite different from that used in other temperature-operated traps. In the cutaway view, flow is from the right to the left. The ball valve is opened by the pressure of the condensate, but closed by deflection to the right of a powerful multi-leaf bimetal. The most unusual feature of this arrangement is that the bimetal is chosen to have a force characteristic similar to the temperature-pressure curve for saturated steam. This means that for any temperature of saturated steam in contact with the bimetal this deflection force is just sufficient to hold the valve closed. Thus, when condensate at slightly lower temperature surrounds the bimetal, its deflection force is slightly decreased and the pressure of the condensate opens the valve. This characteristic of operating force vs. steam temperature is maintained throughout the entire range from 213 deg. F. to about 550 deg.

This means that only one style of trap is necessary to handle any pressure within that range, except, however, that for pressures from 350 to 650 psi., a wider trap with a double bimetal element is employed in order that the bundle of leaves will not become too thick. The new construction is said to permit simplest and lowest cost piping, to give maximum capac-

(Continued)

THIS ELLIOTT TURBINE-DRIVEN AIR BLOWER serves the new fluid "cat" cracker which recently went into service at the Big Spring, Texas, refinery of Cosden Petroleum Corporation. It provides the air for conveying and reactivating the catalyst. Installed at an elevation of 2600 feet above sea level (13.3 psia barometer), this blower is rated at 15,500 inlet cfm and discharges at a pressure of 25 psig. It is direct-connected to an Elliott 1575-hp condensing steam turbine operating at 5900 rpm.

Continuity of operation is an essential of "cat" crackers and other process requirements—an emergency shutdown may result in serious damage to equipment and prolonged loss of production. Elliott units have been designed with this requirement in mind and operating records prove conclusively that they have the rugged dependability necessary to meet the most exacting requirements. Contact your nearest Elliott representative for details.

P-1090

ELLIOTT COMPANY

Electric Power Dept., RIDGWAY, PA.
Steam Turbine Dept., JEANNETTE, PA.

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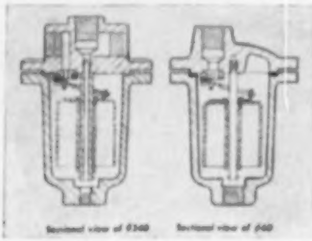
DISTRICT OFFICES IN PRINCIPAL CITIES

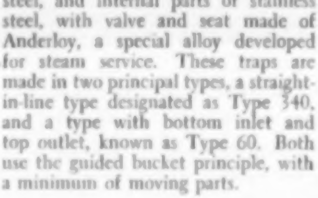
ity, and to minimize maintenance. Extremely simple construction is possible in that only one valve is required and no separate air venting arrangement is necessary. Because of the extremely wide liquid handling capacity of the trap, only the single size, with ¼-in. orifice, is produced.



FOR HIGH PRESSURES, TEMPERATURES:

Forged-Steel Trap

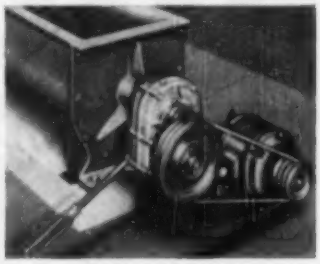
(154A) Sizes for ½- and ¾-in. pipe connections are available in a new line of small forged-steel steam traps offered by the V. D. Anderson Co. Designed for high-pressure, superheated steam service, these traps are suitable for steam of 800 deg. F. total temperature, and pressures to 500 psi. Head and body are of forged steel, and internal parts of stainless steel, with valve and seat made of Anderloy, a special alloy developed for steam service. These traps are made in two principal types, a straight-in-line type designated as Type 340, and a type with bottom inlet and top outlet, known as Type 60. Both use the guided bucket principle, with a minimum of moving parts.



WIDE VARIETY AVAILABLE:

Teflon Packings

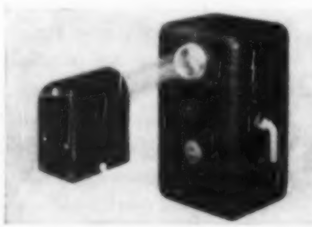
(154B) Garlock Packing Co. is now producing a wide variety of Teflon packings and gaskets for use against practically all chemicals at temperatures from −90 to +500 deg. F. Included are coil, ring, and sheet packings; gaskets, tape, disks, cups, and other molded shapes. Both solid Teflon types and types containing shredded and filament Teflon are produced.



EASY INSTALLATION:

Torque-Arm Reducer

(154C) What is claimed to be the only torque-arm reducer for output speeds from 115 to 330 rpm. is a new type introduced by the Dodge Mfg. Corp. in four sizes for capacities up to 27 hp. The new reducer features ease and economy of installation by reason of its shaft mounting, which requires no foundation, flexible couplings, sliding base, or other installation expense. The reducer is driven through a V-belt drive and any required output speed within the range of 115 to 330 rpm. can be secured by proper choice of stock sheaves. Accurate adjustment of the belt tension can be made quickly and easily by operating the turnbuckle in the torque-arm.



GIVES DELAYED ACTION:

Photoelectric Control

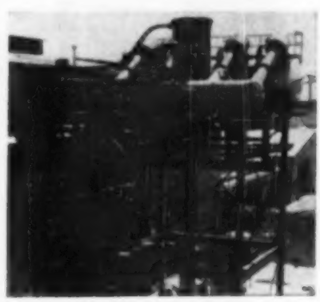
(154D) For applications where time delay is desired between operation of the photoelectric control and initiation of some correcting action, Photoswitch, Inc., has developed the Type PID control. This unit combines a high-speed photoelectric circuit with an electronic delayed-action timer in a single control. One of the most important applications for a control of this type is to indicate the presence of a jam in a conveyor line and stop its motion or set up some other correction. Through the use of the time delay, the relay initiating corrective action operates only after the light beam has been broken for a preset time interval, representing a period longer than that which would normally be required for a package to pass on the conveyor. This can be adjusted for any time delay from 0.05 to 5.0 sec.

FOR DUSTS AND FUMES:

Air-Fed Respirator

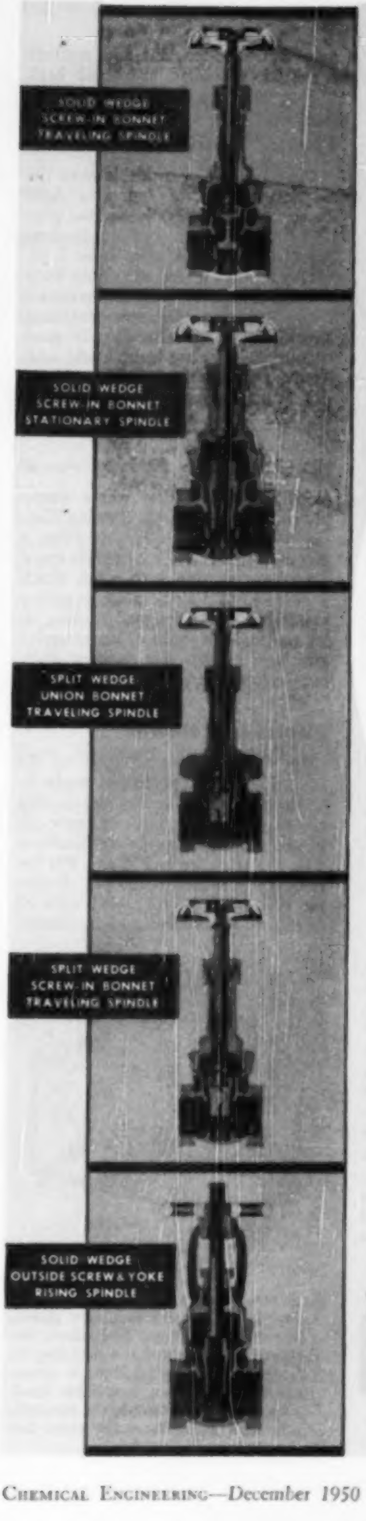
(154E) A new air-fed hood respirator approved by the U. S. Bureau of Mines for Class C toxic dusts and fumes is offered under the designation of No. 600 by the Chicago Eyeshield Co. The hood is equipped with an extra large, clear plastic window with air fed into the hood at each side of the face so as to maintain a clean, cool supply directly in the respiratory zone. The hood is water-

(Continued)



LARGEST PHARMACEUTICAL JET

(154F) Croll-Reynolds Co. has just completed installation for Chas. Pfizer & Co., at Groton, Conn., of what is described as the largest steam jet refrigeration unit ever built for making pharmaceuticals. Its capacity is equivalent to that of a 900-ton mechanical refrigeration unit, which is more than four times the size of the average refrigeration machine used in industry.


SOLID WEDGE
SCREW-IN BONNET
TRAVELING SPINDLE
SOLID WEDGE
SCREW-IN BONNET
STATIONARY SPINDLE
SPLIT WEDGE
UNION BONNET
TRAVELING SPINDLE
SPLIT WEDGE
SCREW-IN BONNET
TRAVELING SPINDLE
SOLID WEDGE
OUTSIDE SCREW & YOKE
RISING SPINDLE

NEW EQUIPMENT, *cont.* . .

proof and acid-resistant and protects the head, shoulders, chest and back against flying particles.

Plastic Containers

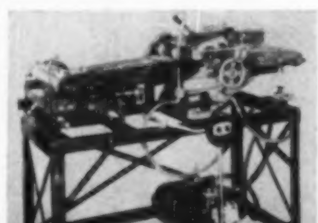
(156A) Now available from the Plastics Division of American Agile Corp. is a series of polyethylene plastic carboys, bottles, jugs and buckets produced in various sizes from 1 pt. to 3 gal. These are fabricated by a process of plastic welding developed by this concern. The new containers are suitable for the handling of most chemicals, including hydrofluoric acid. As recently described in these pages, this company is also producing polyethylene tubing and acid tank liners.

Single-Phase Drive

(156B) For uses where single-phase power is available, Sterling Electric Motors, Inc., is now building a model of its Speed-Trol variable speed drive in sizes from $\frac{1}{2}$ to 3 hp. which is powered by a single-phase capacitor motor. A newly designed starting relay is said to reduce maintenance greatly as compared with usual starting devices in single-phase motors.

Packaged Boiler

(156C) Latest addition to the line of package-type boilers made by Cyclotherm Corp. is a model capable of being fired with light or heavy oil, or gas, or oil and gas in combination. This boiler comes in 350 and 400 hp. sizes, for pressures to 200 psi. Boilers are shipped fully assembled with all necessary equipment and auxiliaries.



LABEL GLUER

(156D) Continuous automatic feed is incorporated in a new glueing machine being offered by Potdevin Machine Co. The entire unit including the feeder and glueing machine is permanently mounted on a portable stand. Tapes convey the sheet to the automatic air wheel which feeds the sheet into the glueing machine.

Light Intensifier

(157A) Light Intensifier Co. has introduced a simple magnifying lens for attachment to a light bulb which intensifies the light in a limited area, giving about 30 percent more light in this area from the same bulb. The intensifier is low in cost and can be installed in a minute.

Elevator Buckets

(157B) Made in five sizes from 8 x 5, to 16 x 8 in., a new line of heat-treated alloy steel conveyor buckets has been brought out by Beaumont Birch Co. Known as Uni-Cast, these buckets are cast integral with a single link of chain so that they cannot loosen or fall off.

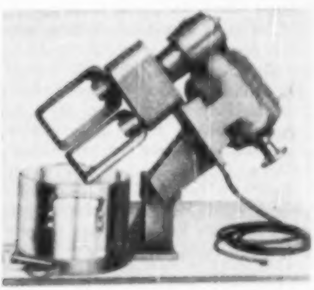
Glove Renovator

(157C) A new idea in industrial glove maintenance is offered by the U. S. Industrial Glove Corp. This concern has now started a glove renovation service for all kinds of worn-out fabric and leather gloves, as well as protective clothing. Gloves can be rebuilt at a fraction of original cost, and it has been found that over 80 percent of them are capable of such salvage.

Gas Hazard Indicator

(157D) Davis Instruments is now marketing its Vapotester Model M-1, Type L, for detecting the pres-

(*Continued*)



MIXES THINGS UP

157E) Small laboratory batches from 1 qt. to 1½ gal. of material are quickly mixed in the new No. 130-EL motor-driven laboratory change can mixer developed by Chas. Ross & Sons Co. This mixer is said to be suitable for most varieties and consistencies of material, but can be run from an ordinary light circuit. It employs a variable-speed drive permitting a wide range of stirrer speeds to be selected. Furthermore, direction of rotation can be reversed.

ence of combustible vapors in the presence of tetraethyl lead; and therefore suitable for use on leaded gasoline. It is said to be the only indicator so far approved for this use, since its sensitive element cannot be poisoned by the lead compound.

Improved Gearing

(*158A*) To reduce wear and vibration in gearing driving such machinery as grinding mills, kilns, coolers and dryers, Allis-Chalmers is using a new design of gearing. This has a tooth profile generated as a true involute with a 20-deg. pressure angle, long addendum pinion and short addendum spur gear. It replaces the 15-deg. tooth form, giving 75 percent more tooth area in contact and precluding interference between gear and pinion. A higher percentage of tooth contact is rolling rather than sliding action.

Packaged Dust Collector

(*158B*) Aget-Detroit Co. has developed a dust collector of 10,050 cfm. capacity, powered by a 15 hp. motor driving a paddle wheel fan which is available on an "off-the-shelf" basis. The collector has a 15 in. inlet and an 18 in. discharge and is recommended for use on practically all types of industrial dusts. It is shipped complete, ready to put into immediate operation.

Miniature Deionizer

(*158C*) For use by those having need for small quantities of deionized water, La Motte Chemical Products Co. has developed a miniature mixed-bed deionizer called the Filtr-Ion. This small device hooks on an ordinary water faucet and is rechargeable after delivering about 10 gal. of laboratory-quality water. It consists of a transparent plastic tube filled with Amberlite ion exchange resins. These resins, made by Rohm & Haas, change color when exhausted.

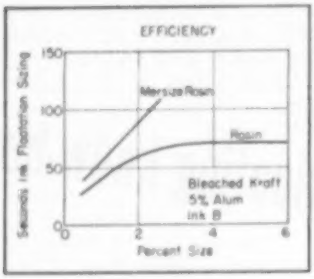
Cottonseed Tester

(*158D*) As a new addition to its line of electronic moisture testers, the Tagliabue Instruments Division has brought out an instrument especially for measuring moisture in cottonseed, cottonseed meal and flake. It can also be used for other seeds and granular materials. It operates on the dielectric principle, is independent of voltage fluctuations, and requires the adjustment of only one dial in taking a reading.

—End

New Products and Materials

RICHARD V. REEVES, Assistant Editor



Kraft pulp sizing with Mersize-rosin.

SAVINGS

Dollars per ton with Mersize

Size Cut	Size level 1%	2%	3%	4%
33%	0	0	0	0
40%	$0.17	$0.34	$0.51	$0.68
50%	$0.41	$0.82	$1.23	$1.64

A superior product with less material.

Thinking on Molecular Level Saves Dollars in Paper Sizing

New resin offers more efficient sizing by improving nature's engineering rosin.

(160A) Just about every paper mill using rosin has run into a sizing problem at one time or another. Usually hard-sized sheets presented the most frequent difficulties. One solution was to chuck the straight rosin and adopt an expensive modified one or equally expensive beater additives. But increasing costs is a lame duck remedy at best.

That left a lucrative field wide open and Monsanto grabbed the ball. Result is Mersize CD-2. The company says it's not just another trick preparation of rosin, but a new synthetic resin expressly designed for sizing paper. The formulation calls for three parts rosin and one Mersize (both dry basis). This combination allows as much as a 50 percent reduction in total pounds of size in the furnish. Quality and efficiency go up while costs go down. Other advantages include a smaller amount of lost machine time because the new resin imparts greater temporary wet strength; a lesser degree of feathering as measured by the ink-flotation test, and many more.

Chemistry of the resin amounts to better construction on a molecular level. Basically, the carboxyl groups of rosin react with the aluminum ions in the alum and these in turn with the pulp. Hydroxyl groups are the key and all Monsanto did was to provide more of them on a smaller molecule. Not only is such a molecule more reactive with its increased functional groups, but its small size eliminates the steric hindrance encountered with bulky rosin molecules. The Mersize hydroxyl groups combine readily with the regular amount of alum used to precipitate the size. Consequently, though the total amount of size may be reduced by half, the same amount of alum is used. No significant change occurs in the pH.

The product is easy to use. No special processing, mixing, or cooking are required to improve engine sizing. The liquid resin also possesses a low viscosity and can be handled almost as easily as water. It is unaffected by heat, cold, or long storage.

Cost is 11.75 c. per lb. Savings are as follows: For rag and bleached sulphite papers, a 50 percent cut in total size can be made and equal sizing still may be obtained. If greatly improved sizing is desired, it may be obtained with a reduction of 30 percent total size. For lower grade pulps, a 40 percent reduction most frequently gives equal sizing; a 30-35 percent reduction will give better sizing. When high cost premium sizes are used, the reduction of total size required will be somewhat lower but the money saving will be approximately equal.

The product will save the greatest amount of money per ton in papers that require the hardest sizing, and which therefore require the largest amount of size. While the type of pulp has some effect on the action of Mersize, a paper normally requiring from 3 to 4 percent of rosin may be sized better and more economically with the rosin-Mersize combination regardless of pulp. According to Monsanto, with papers containing 1 percent or less rosin size, it is definitely an advantage to have the central size system feed the single Mersize-rosin combination for all furnishes.

Several actual mill trials have reported excellent results.

FIGHTS COLDS:

Synthenate Tartrate

(160B) A brand of p-methylaminoethanolphenol tartate named Synthenate Tartrate, described as an effective aid against the common cold, is now being offered as an injectible prescription specialty by George A. Breon and Co.

It has been described as faster than many of the antihistamines, without the side-effects such as nausea and drowsiness. Synthenate Tartrate, when used promptly at the first evidence of coryza (sniffles and sneezing), is particularly useful to industrial physicians to keep down lost time due to colds among employes in large plants, the manufacturer states.

COMMERCIAL QUANTITIES:

New Chemicals

(160C) Two derivatives of thiophene are now available from Monsanto Chemical Co. in commercial quantities. The derivatives are: phenyl-2-thienyl ketone and 2-thiophenecarboxaldehyde. They are suggested as intermediates in the pharmaceutical and other fields. Another derivative, 2-bromothiophene, is being manufactured in pilot plant quantities.

Also in the pharmaceutical field is TB-1, p-formylacetanilide thiosemicarbazone, a chemical suggested for use in anti-tubercular therapy and now available in commercial quantities.

Among the products of interest to the agricultural chemicals industry are 4-chloro-2-methylphenoxyacetic acid, a homologue of 2,4-D, suggested as

a selective herbicide, and dimethyl p-nitrophenyl thionophosphate, a homologue of parathion, suggested as an insecticide and miticide.

In the dyestuff and textile fields, three commercial products: Catalyst AC-4, a catalyst for melamine resins; Dyefixative 105, a cationic resinous compound to reduce bleeding of direct dyestuffs; and Merlon KR-2, an aqueous dispersion of polyvinyl acetate resin to impart stiffening effects to textile fabrics.

Another of the new chemicals from Monsanto is Colloidal Aluminum Phosphate D, to confer high green strength and good high temperature bonding to heavy duty refractories and other ceramics. It is a glassy, thermoplastic, colloidal aluminum phosphate milled with ceramic grade clay as a parting agent.

Other products are *p,p'*-diisocyanatodipheyl methane, suggested as an ingredient in foamed resins and adhesives, and Redwood Rez, a pigmented sealer to reduce or prevent fading and discoloration of redwood.

NEW MOTOR FUEL:

Bottle Gas

(161A) Bus operators are showing an increasing interest in liquefied petroleum or bottled gas as a fuel in place of gasoline, according to Socony-Vacuum Oil Co. Rising operating costs in the bus industry, the availability of engines with higher compression ratio and a steady supply of bottled gas are all instrumental in arousing the interest.

Automotive use of LPG is not entirely in the new or experimental stage. Conversions to LPG have been made on heavy trucks, off the road vehicles, rail cars and industrial engines.

California is the largest user in internal combustion engines. It is estimated that 2,000 trucks and 20,000 pieces of farm and highway construction equipment in the state run on bottled gas. One bus line in Spokane used it for 18 yr. About 3 percent of LPG sold in the U. S. is for automotive use.

In the Southwest and Midwest surrounding the LPG producing area, LPG is expected to make considerable inroads in the farm tractor field. One company estimates that 30,000 tractors will be converted to LPG this year.

A bus or other LPG powered vehicle requires several mechanical changes. It must have an LPG gas pressure tank, a converter instead of a fuel pump, gas carburetor for gasoline liquid carburetor, a cold manifold for exhaust hotspot, a high compression ratio engine for one of intermediate compression, cold spark plugs for those of intermediate range. Special hose and fittings are also needed.

Conversion from gasoline to LPG engines and necessary fittings can be made for about $350 to $500. When the engine is purchased as part of a new vehicle, difference in cost is only about $350. In addition to the cost of converting the vehicle, additional costs for storage facilities are involved. Facilities for serving a fleet of 60 buses would amount to approximately $250 a vehicle. This can be considered a small sum in comparison to the total cost of a typical 38-44 passenger city bus—something like $15,000-$20,000.

LPG, with its higher octane number, makes knock-free operation at higher compression ratios possible, giving greater power output. On the limited experience in the use of LPG by bus operators, some report mileage the same as with gasoline, others slightly more or less. The more volatile LPG is a cleaner burning fuel than gasoline, reducing engine difficulties from deposits. Other claims for the gas are that dilution of the crankcase oil is eliminated and that wear caused by the washing action of gasoline during starting is reduced. Overhauls should not have to be made as frequently. Also smoke and odor of the gasoline engine is largely eliminated by using LPG.

One of the obstacles to its widespread use has been in legal and safety regulations although the safety record of the gas has been substantially good. Another problem with LPG has been fluctuations in price; its acceptability depends on its price being lower than gasoline.

LPG may be either wholly propane or butane gas, or mixtures of the two in various proportions. The principal sources of LPG are crude oil wells, natural gas wells, gas distillate wells and refinery operations.

WRINKLE RESISTANT:

Textile Finish

(161B) A textile finish that will impart durable wrinkle resistance and shrink resistance to cotton and viscose rayon fabrics has just been developed and placed on the market by the Du Pont company.

The material has been trade-marked Zeset. For the American housewife, a principal consequence of its development is the fact that:

Spun viscose rayon fabrics, many of which are not now washable, can, when treated with Zeset durable wrinkle resistant finish, be laundered and bleached under the usual home conditions without the serious loss of strength and discoloration frequently encountered in the case of home-bleached fabrics.

Zeset not only makes cotton and viscose rayon resistant to wrinkling and shrinking, but it gives both categories of fabrics a soft, wool-like finish rather than the harsh, boardy effect produced by certain of the earlier wrinkle and shrink resistant finishes.

It imparts a degree of shrink resistance to viscose rayon that it is not possible to attain without finishes of this type, and its development is expected to enlarge the wash goods field for manufacturers of spun rayon fabrics.

An outstanding characteristic of the

(*Continued*)

New This Month . . .

More Information . . .

To find out more about any of these new products, circle the item's number on Reader Service Postcard inside the back cover.

Here's what lime soap grease looks like. Original photomicrograph (shadowed with gold) taken at 81,300X by A. Y. Mottlau of Standard Oil Development Co.

material from the standpoint of the textile processor, is the ease with which it may be applied and the fact that its use eliminates many of the problems formerly associated with the application of crease-resisting and stabilizing materials.

The finish can be applied by any mill possessing efficient padding, drying, heat treating, and washing equipment used in applying thermosetting resins. It is diluted by simply mixing with water. Unlike earlier finishes in its field which tended to set up during application, Zeset is stable during storage and the treating baths are stable for days at room temperature.

It may be used with Zelan durable water repellent, and a combination of these two finishes on viscose rayon imparts to that fiber water repellency, and the wrinkle resistance associated with wool. The new finish also may be used with softening or stiffening agents to modify the hand and feel.

To date, the finish has been applied primarily to viscose rayon and cotton fabrics, but applications for it are indicated in the treatment of linen and pile fabrics such as transparent velvets.

While most spun viscose rayon fabrics lend themselves admirably to treatment with Zeset, cotton fabrics must be properly selected for application of the finish. In general, cotton fabrics made of combed yarns and mercerized are better suited for processing with the finish.

VERSATILE:
Resin Cement

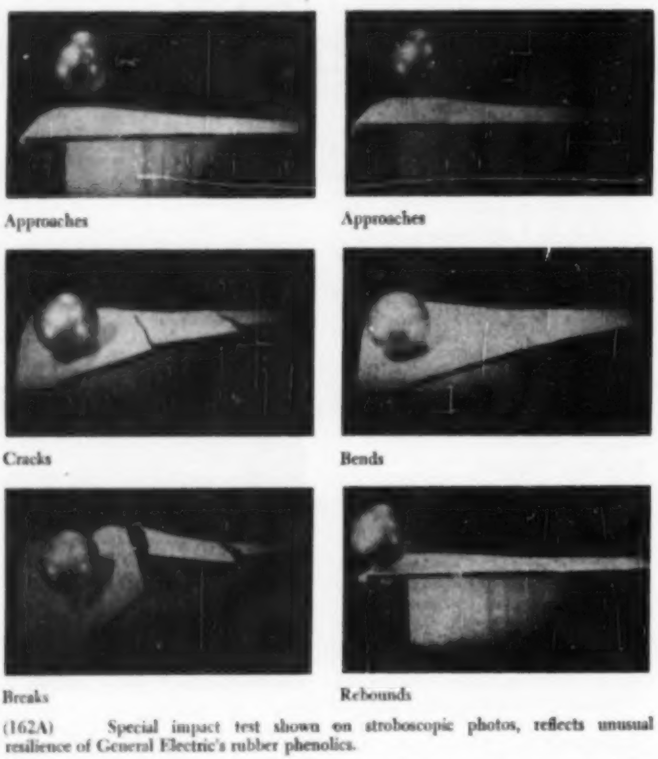
(162B) An all-purpose resinous cement called F-66 is based on furan resin, marketed by Nukem Products Corp. The maker claims that the jointing compound is immune to strong solutions of practically all commercial acids, alkalis, salts or solvents to 350 deg. F.

Other characteristics of the cement: tensile strength 1,200 to 2,400 psi.; compressive strength 12,000 to 16,000 psi.; versatile chemical resistivity; hardening without shrinkage; durability; strong adhesion and many others.

Suggested uses: jointing compound for all types of acid brick sheathing; in process or acid neutralizing tanks, pits, sewers, vats, towers and many more.

DROP BALL TEST . . .

. . . on Phenolic — . . . on Rubber Phenolic



Approaches — Approaches

Cracks — Bends

Breaks — Rebounds

(162A) Special impact test shown on stroboscopic photos, reflects unusual resilience of General Electric's rubber phenolics.

EASIER MOLDING:
Silicone Rubber

(162C) A new silicone rubber compound developed by the Chemical Dept. of the General Electric Co. now permits rubber fabricators to mold silicone rubber parts easier and with highly improved mechanical and thermal properties.

Designated as 81223 compound, the new silicone rubber is noteworthy for its ease in processing. Many parts can be fabricated from it without prolonged oven cure and it has good molding and extrusion properties after only a 5-min. warm up. Because of the favorable hot tear strength of the rubber, parts with undercuts can easily be removed from molds; and being neutral in color, stock can be colored for product identification purposes for individual fabricators.

Fabricated parts obtained with the new compound have high tensile strength, high elongation, good electrical properties, and are serviceable over a wide temperature range (550 deg. F. to −95 deg. F.

Many new applications for silicone rubber mechanical goods, including diaphragms, boots, sleeves, belting, hose, and mountings, are anticipated as a result of the improved molding characteristics and improved properties of the new compound.

MORE EFFECTIVE:
Weed Killer

(162D) Encouraging evidence that aerial sprays of a new chemical (2,4,5-T) can be used in North Texas to kill mesquite, is reported by plant scientists of the U. S. Dept. of Agriculture and the Tex. Experiment Station.

As a preliminary step toward solving the gigantic problem of brush control on several million acres in the Southwest, the finding is of keen interest. It offers, for the first time, a mass method for fighting mesquite in the less arid sections of the range country at comparatively low cost. It is believed also to hold clues to control methods for the pest in other environmental conditions where it

(Continued)

thrives and for other species of brush that are not affected by either 2,4,5-T or the better known weed killer, 2,4-D.

The experiments with mesquite at Spur, Tex., show that it can be killed by aerial sprays of 2,4,5-T applied late in May when the brush is in vigorous growth. The treatment is similar to that in which 2,4-D is now used to control sagebrush on the grasslands of the southern great plains.

For mesquite the scientists used 2/3 lb. of the ester form of 2,4,5-T in 5 gal. 20 percent oil emulsion. Cost of this treatment for large scale operations is estimated at $3 an acre. The kill is 98 percent for the tops of the brush and more than 50 percent of the roots. The chemical has given 65 percent kill when applied as a ground spray to mesquite foliage and up to 90 percent kill when used to treat the cut surfaces of stumps. Spray applications to the lower 12 in. of the trunk have killed both tops and roots.

Experience with mechanical destruction of mesquite shows that this method does not assure eradication of the brush. In addition to its extensive root system, mesquite has an underground bud-zone from which a score or more new sprouts may shoot up when the tree top is injured. A damaged tree often produces a thicket within a few years. The need for repeated chemical treatments is one aspect of the problem that must be studied much more intensively.

VERSATILE:

Butynediol

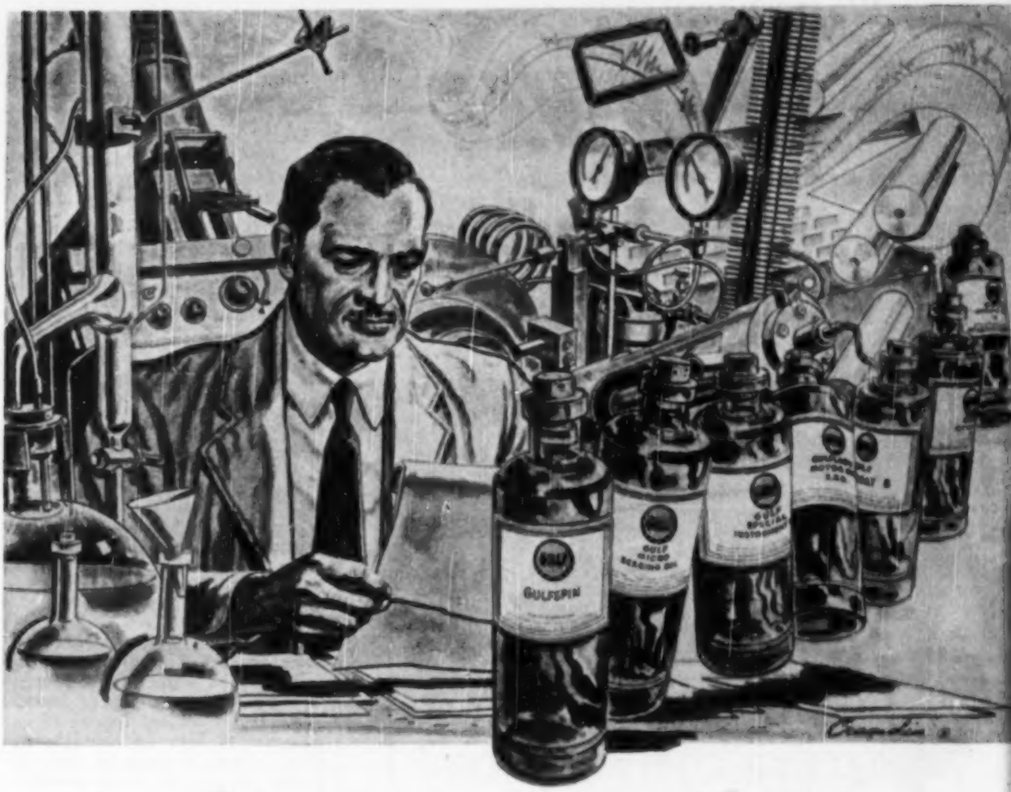
(*164A*) A derivative of acetylene, butynediol, (2-butyne-1,4-diol), is currently turned out at General Aniline and Film's Grasselli plant. It may be had as a 35 percent aqueous solution from which anhydrous crystalline butynediol may be readily isolated.

The two primary alcohol groups and the triple bond carbon to carbon configuration of the structure give the chemical a versatility which assures that it will become a building block in organic synthesis.

Butynediol undergoes such reactions as hydrogenation; addition of water, alcohols, hydrochloric acid, and sodium bisulphite; amination; esterification; etherification; trimerization and isomerization.

Many chemical intermediates can be derived from butynediol, including 2-butene-1,4-diol, 1,4-butanediol, tetrahydrofuran, γ-butyrolactone, and γ-cyanobutyric acid. These compounds are interesting as stepping

(Continued)



New Improved Gulf Lubricants

offer effective help in your efforts to cut costs!

OUT of the Gulf Research Laboratories have come more new and improved petroleum products to help you gain an edge in the "Battle of costs"!

New Gulfspin, revolutionary spindle oil, helps textile mills reduce maintenance and power costs.

New Gulf Micro Bearing Oil and Gulf Special Instrument Oil provide long-lasting gum-free lubrication for small precision bearings and gears.

New Gulflube Motor Oil X.H.D. reduces sludge deposits and engine wear, extends overhaul periods for light delivery and taxicab fleets.

New Gulf Block Grease provides a new kind of lubricating performance in quarries and cement plants.

New Gulf Cam Grease helps coal mines reduce maintenance costs for shaker screen cams and eccentrics, eliminates lubrication troubles.

These are just a few of the quality Gulf products that can help you improve production and reduce costs. Call in a Gulf Lubrication Engineer today and ask him to recommend the most suitable oils and greases for your equipment and operating conditions. Write, wire, or phone your nearest Gulf office.

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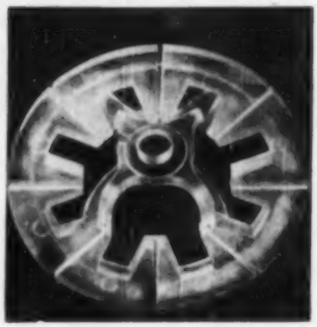
stones in the synthesis of other valuable products several of which have not been commercially feasible up to now.

Direct application has been found for butynediol as an inhibitor in the hydrochloric acid pickling of steel and as a vinyl polymerization accelerator.



MOLDABILITY:
Polymeric Material

(166A) Intricate tube base above was developed from trifluorochloroethylene by the M. W. Kellogg Co. The material otherwise known as Kel-F was selected because of its resistance to high temperatures, its good mechanical properties, high dielectric strength and ready moldability.

Indicative of the excellent moldability of the material is the fact that the tube base is ready for use when taken from the mold, requires no machining even for the narrow slots which hold contact clips in position in the final assembly.

HEAVY DUTY:
Glyptal Resins

(166B) Three new General Electric glyptal alkyd paint resins have been introduced. These include a fast-baking glyptal resin designated as 2522 for industrial finishes, and two glyptal resins: 7300 for architectural finishes and 7310 for industrial finishes.

Resin 2522 is a fast-drying, hard, tough material that combines excellent adhesion and gloss and color retention, with chemical resistance, weather resistance, and flexibility. Glyptal 2522 is compatible with amine resins, but for many applications their addition is not required.

Resin 7300 is a general purpose alkyd designed for architectural applications.

Designed as a rapid, tough-baking (Continued)

vehicle for industrial type finishes, resin 7310 has excellent weather resistance, increased color-retention, and is recommended for a wide variety of metal products including farm machinery, machine tools, and gasoline pumps. It may also be used for air-drying enamels.

TWO COLORS:
Enamel

(168A) What the manufacturer terms the world's first multi-colored enamel has just been developed by the United Lacquer Manufacturing Corp. Called MultaColor, it may be prepared in any combination of two or more colors which may be applied in a single coat.

When sprayed, brushed or applied by the dip process, the result is a uniformly distributed broken-surface finish. In laboratory test runs, the new enamel has been used effectively to finish a wide range of products.

Company officials say that the new enamel provides a more economical and attractive finish for products which previously have been finished in one or more colors. They also claim a saving of as many as four steps from now-standard finishing operations.

MORE PERMANENT:
Glass Cement

(168B) A new corrosion resisting cement, for patching glass lined vessels subjected to heating and cooling cycles, has a coefficient of expansion so close to the basic mate-

(Continued)

1st in the Nation

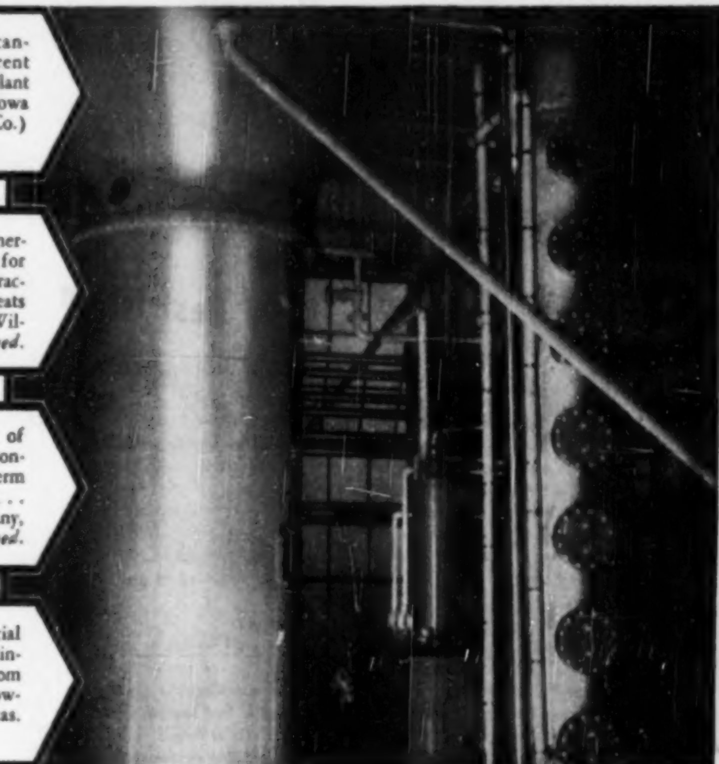
IN CONTINUOUS SOLVENT EXTRACTION

SOYBEANS First American-made continuous, counter-current soybean oil solvent extraction plant . . . Cargill, Inc., Cedar Rapids, Iowa (formerly Honeymead Products Co.) *Allis-Chalmers equipped.*

COTTONSEED First commercially successful unit in the world for direct and continuous solvent extraction of oil from cottonseed meats . . . Delta Products Company, Wilson, Ark. *Allis-Chalmers equipped.*

CORN GERM First unit of American design to extract oil continuously from prepressed corn germ by means of petroleum solvents . . . Corn Products Refining Company, Argo, Ill. *Allis-Chalmers equipped.*

RICE BRAN First commercial installation in the world for continuous solvent extraction of oil from rice bran . . . American Rice Growers Coop. Assn., Houston, Texas. *Allis-Chalmers equipped.*



YES, ALLIS-CHALMERS was first in the nation to provide *American-made* equipment to *American* mills for the continuous solvent extraction of soybean, cottonseed, corn germ, and rice bran oils. And with this long line of "firsts" has come merited recognition to A-C as an authority on solvent extraction equipment and techniques.

It will pay you to take advantage of this vast pioneering experience. Learn from Allis-Chalmers how *production-proved* A-C equipment can mean greater dollar return in your mill. When you turn to Allis-Chalmers, you get straight facts on continuous solvent extraction processes — backed by long years of sound engineering and production experience.

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A-2874

New Products, cont. . .

rials patched that loosening is accomplished only under severe test. Carboline Corp. is the maker. The new material is called Carbo-Fix 6050.

Patches placed in an oven at 300 deg. F., for half an hour, then water quenched, lasted from 20 to 32 cycles before loosening—five to nine times as long as other glass lining cements tested. Such testing exceeds normal reaction vessel conditions and gives promise of service without the need for anchoring patches with plugs and plates or gaskets.

The procedure is to mix three materials together before application. Exposed steel must be primed but rough glass does not. The patch dries at room temperature but can be dried more rapidly by use of an infrared lamp.

Alkyl Phenol

(170A) A new alkyl phenol has recently been introduced by Jefferson Chemical Co., Inc. This new product, alkyl phenol C-9, is a mixture of monoalkyl phenols predominantly para substituted. The hydroxyl number is 253. It is a pale yellow liquid possessing a relatively high viscosity and a characteristic phenolic odor. Alkyl phenol C-9 has possibilities as a nonionic detergent intermediate, in the manufacture of lubricating oil additives, and in the preparation of various resins and plasticizers. —*Jefferson* resins and plasticizers.

Trifluoroacetic Anhydride

(170B) Halogen Chemicals Inc. is now offering in research quantities trifluoroacetic anhydride, a powerful esterification agent. A pungent, water-white liquid boiling at 40 deg. C., trifluoroacetic anhydride has been found to be especially valuable to promote ester formation between hydroxy compounds and carboxylic acids, both aliphatic and aromatic. The conditions of esterification are relatively mild and the reaction is usually complete within a few minutes.

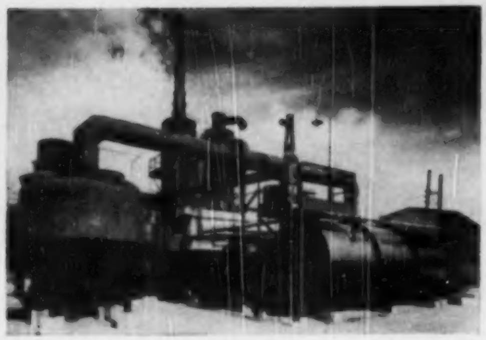
Industrial Antibiotics

(170C) Two new antibiotics, Netropsin and Thiolutin, which may have industrial as well as therapeutic uses have been revealed by Chas. Pfizer and Co.

Preliminary tests on Thiolutin indicate that it may be effective in combating fungi. Netropsin has shown great promise as an insecticide, particularly against clothes moths and carpet beetles, two of the most destructive insect pests.

—End

American Cyanamid gets bauxite from British Guiana or U. S.



Sulphuric is made by subsidiary, Chemical Construction Corp.

Alum

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

Production of alum—aluminum sulphate—consists essentially of one chemical reaction, the replacement of hydroxide by sulphate. Bauxite plus sulphuric acid yields alum.

Bauxite ore comes to American Cyanamid's Mobile, Ala., alum plant by hopper-bottom railroad car. It is taken from storage shed to top of the silo by bucket conveyor. As required, it is ground, pulverized and stored to await use in the process.

The 98 percent sulphuric acid, made in an adjacent unit, is pumped from steel storage tanks to a measuring tank. From there it flows by gravity into the digester.

This reaction vessel is a large steel tank, equipped with a steel stack which carries off the fumes. The tank is lined with lead and acidproof brick, a type of construction which stands up well under severe corrosive conditions.

Acid is first charged into the digester. It is simultaneously diluted and heated to boiling. To bring the acid to boiling, live steam is dispersed through spherical high-silicon iron heaters. Dilution is done by weak liquor from the sludge washing operations.

Finely powdered bauxite in the storage tank is picked up from the bottom opening by chain conveyor and discharged into the weigh hopper on the floor above. From there it passes into the digester as rapidly as the foam created by the reaction will permit. When all acid is neutralized, additional weak liquor is added to bring the slurry into handling condition. Reaction temperature is about 275 deg. F.

When the batch in the digester is completed, the slurry is pumped through a lead-lined trough to cypress-stave settling tanks. Here the alum stands until all sand, clay and other insolubles settle to the bottom. A $\frac{1}{2}$-in. perforated water line around the outside and near the top of each strong liquor tank washes down any foam that may overflow. The water also tends to keep the tank wood moist thus preventing any aging.

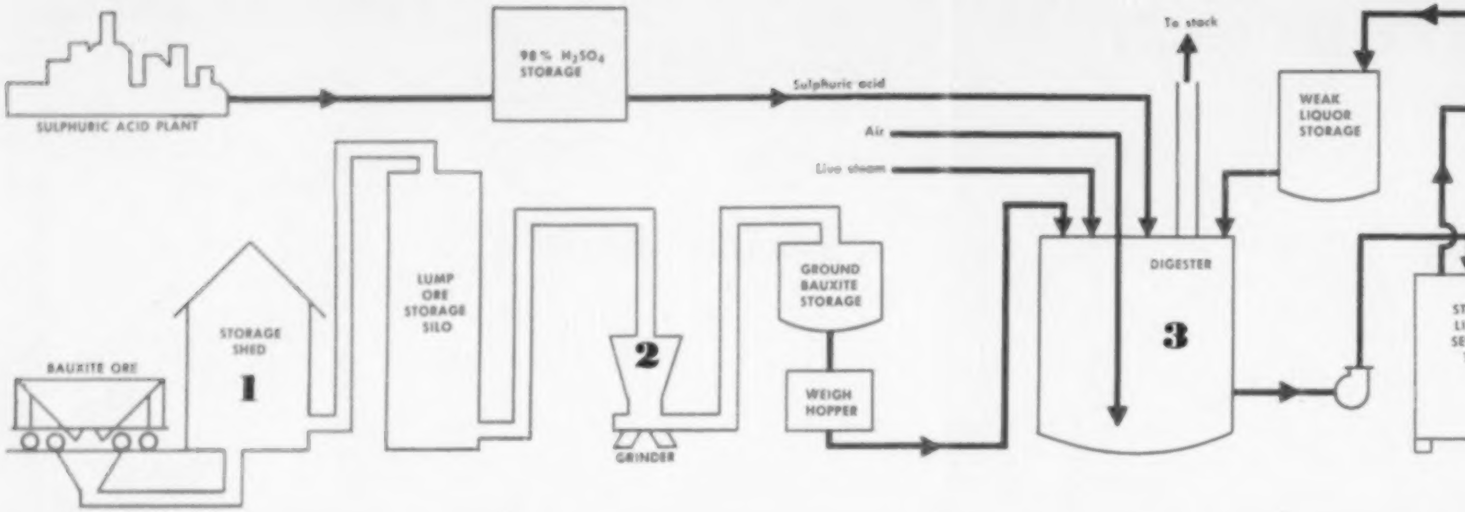
Clear liquor of aluminum sulphate is decanted off through a red brass swing line and passes through a lead-lined head box. The solution is (1) shipped in rubber-lined tank cars, (2) piped through a red brass line to an adjacent pulp mill, or (3) drawn off and pumped into evaporators. Durimet 20 alloy pumps handle the solution. The liquid alum storage tanks are lead-lined fir.

After the alum solution is decanted off, the mud, or insolubles, remaining in the settling tanks is hosed out through clay pipes to a pump pit. There it is transferred by alloy pumps through cypress troughs to cypress wash tanks and well water is added. Air is used for mixing. Wash liquors move batchwise countercurrently through muds in several wash tanks and finally back to the strong liquor settling tanks. In the final wash, mud and fresh water are mixed through the pump and then passed to a discharge tank. This assures good mixing on the last washing and prevents any chance of the operator dumping strong mud into the sludge pond.

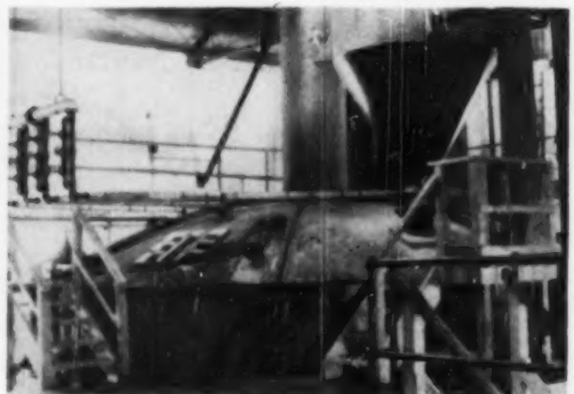
For producing solid alum, the solution is pumped to open-type steel (lead-and-brick-lined) evaporators. Steam coils in the evaporator are red brass. The concentrated liquid alum is discharged onto the steel floor to cool and solidify.

Solid alum is broken and thrown over to slab storage nearby. A chain conveyor takes it to the crusher. From there it may be ground, pulverized and screened, or it may be shipped as lump. Four-ply paper bags are used for domestic trade and either six-ply or burlap for export. Covered hopper cars are used for bulk shipment.

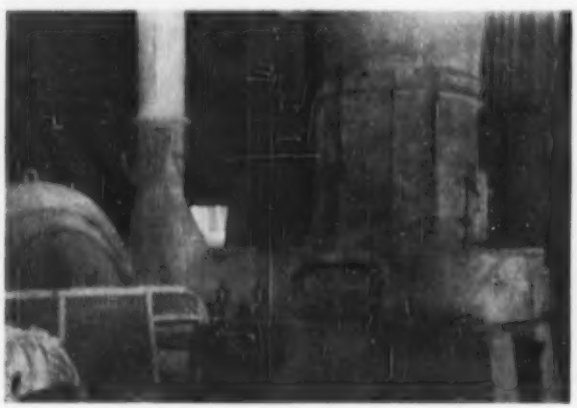
This plant, one of seven operated by American Cyanamid Co., was located at Mobile to supply the pulp and paper mills of the area. Surplus acid and alum are shipped to other consumers in this country or abroad.



1 Ore goes by bucket elevator from storage shed to silo or processing.

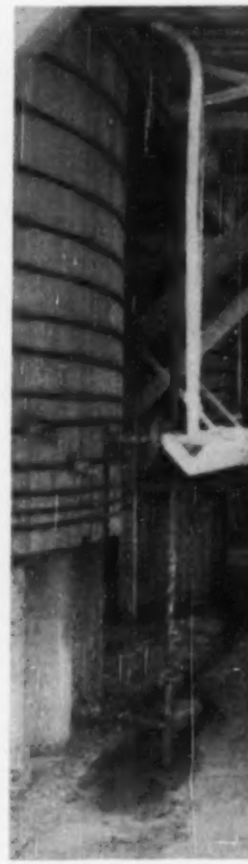


2 Bauxite goes into boiling acid in lead and brick-lined steel digester.

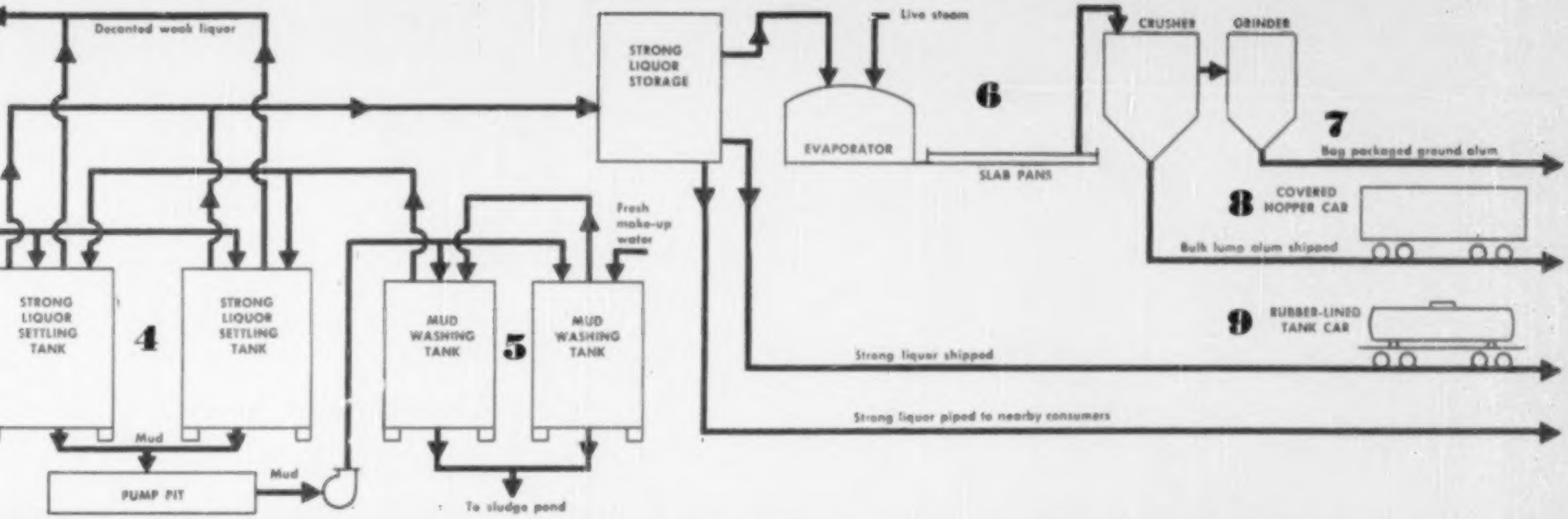


3 Bauxite grinder finely pulverizes lump ore for digester operation.

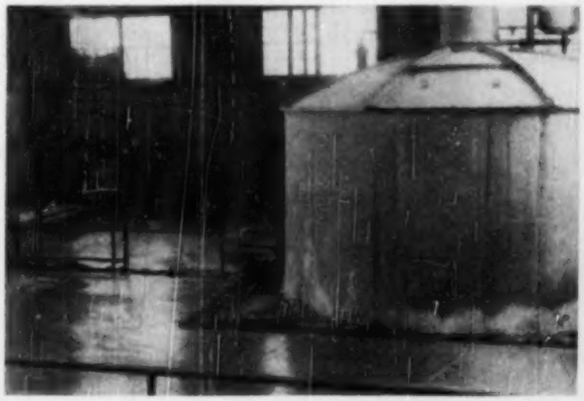
4 Completed digester batch is pumped to cypress stave settling tanks.



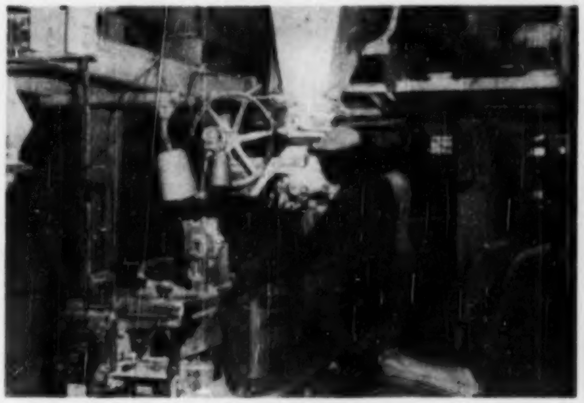
5 Aluminum sulphate is deca



... decanted; insolubles go to cypress wash tanks.



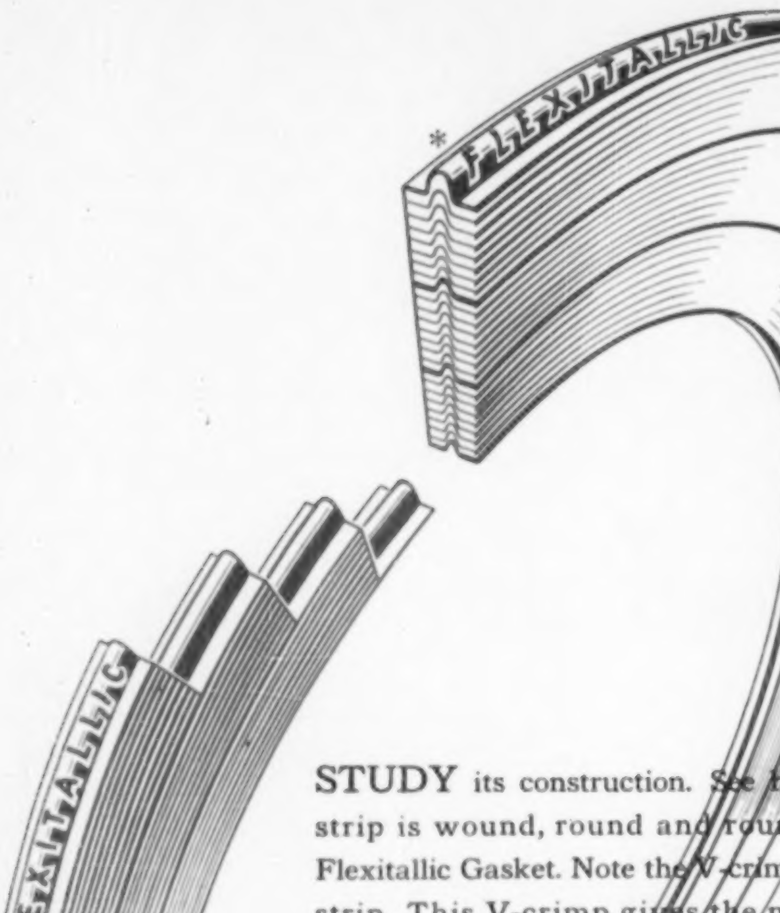
6 Alum solution is evaporated then cooled and solidified on slab pans.



7 Part of the pulverized alum is shipped in four or six-ply paper bags.

8 Covered hopper cars are used for bulk shipment of lump or ground alum.

9 Liquid aluminum sulphate is shipped in these rubber-lined tank cars.



STUDY its construction. See how the metal strip is wound, round and round, to build a Flexitallic Gasket. Note the V-crimp in the metal strip. This V-crimp gives the metal strip its strong spring action. Note the plies of filler separating the plies of metal. This filler permits the spring to function freely and holds the metal strip at right angles to the flange faces . . . This basic Flexitallic principle lends itself to almost unlimited variation . . . Properties of metal, type of filler, relationship of metal to filler—all are variables in the hands of the Flexitallic engineer. Using the most precise instruments for determination of yield values, resilience and density, he builds each Flexitallic Gasket for operation at specified temperatures and specified pressures, and to meet particular conditions of thermal and physical shock, corrosion, vibration, or unusual joint stress. Write us your requirements. Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities of the world.

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CASE HISTORY FROM CRANE FILES

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WORKING CONDITIONS: Valve to control flow of steep
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SOLUTION: Crane No. 1611 Diaphragm Valves, iro
design, with separate disc and diaphragm.

RESULT: Costly problem of frequent repacking complete
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or wear on internal parts—even after 4 years' service.
Crane Diaphragm Valves have already given more than
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*More proof of the fact that in all types of valves, Crane Quali
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More CRANE VALVES are used than any other make

The installation—at American Maize Products Co., Hammon

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on request through your
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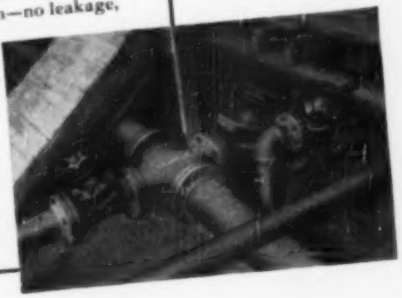

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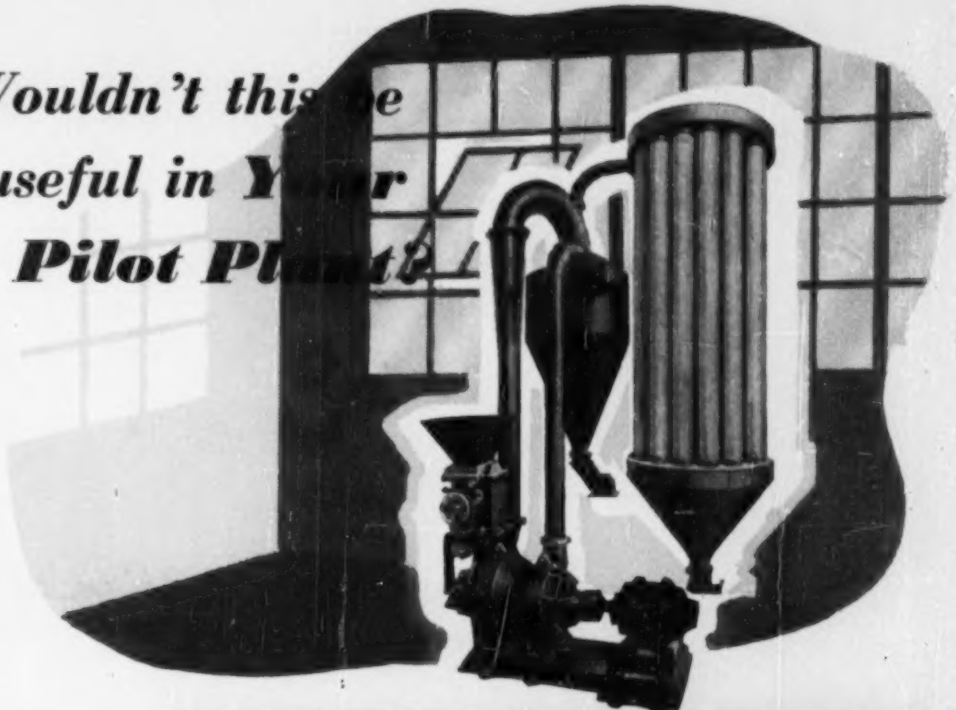

RAYMOND No.0000 PULVERIZER

Flow sheet showing #0000 Pulverizer in closed circuit with Mechanical Air Separator.

THE Raymond No. 0000 Pulverizer is a compact, self-contained pulverizing unit, particularly intended for research and development programs and pilot plant operations.

This unit is especially adaptable to handling non-abrasive, non-metallic chemicals and foodstuffs. It is clean and dustless in operation and takes a minimum of floor space. The interior of the Pulverizer is unusually accessible, and adjustments can be made or the unit cleaned out for a different product in a very short time. Best of all, results obtained from this small unit can be accurately projected to commercial size mills.

Many pilot plant installations also use a Raymond 30-Inch Air Separator in closed circuit with the Pulverizer, similar to the illustration at the left. The Separator makes available a much wider range of finenesses, as well as more uniform materials.

This unit may be just what you require for your pilot plant. Write for Catalog No. 67 and tell us about your operation.

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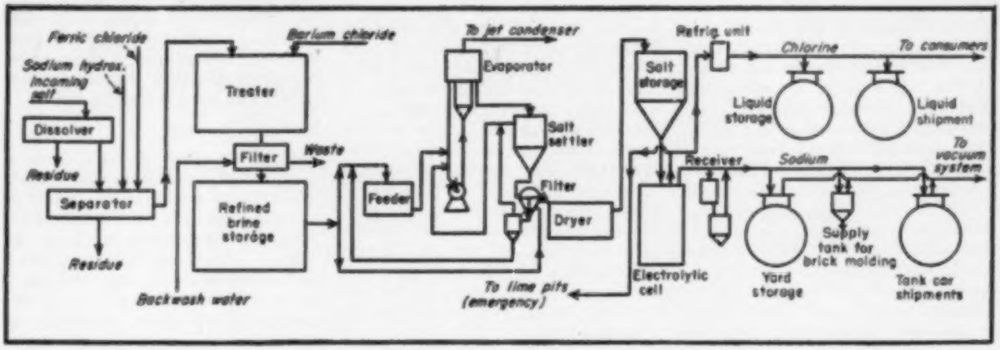
Chemical Engineering News

JOSEPH A. O'CONNOR, News Editor



National Distillers Gets Into Sodium Production Ahead of Schedule at Big Ashtabula Plant

Chemical workers at the big modern National Distillers Chemical Corp. plant in Ashtabula, Ohio, have virtually pushed ahead of construction workers in their drive toward maximum production of metallic sodium. Estimated daily capacity of the huge plant—when all its 94 Downs cells are operating—is 100,000 lb. of sodium and 154,000 lb. of chlorine. The new plant has been pushed toward capacity production ahead of schedule. Already, National Distillers is planning to shell out between $300,000 and $400,000 at Ashtabula to step up output. An additional chlorine liquefaction unit is being installed. And it wouldn't be surprising to hear before long that the company was contemplating the addition of another cell line.

ALL-OUT EFFORT

Production with safety takes precedence over all activity at National Distillers, where David S. Nance, plant manager, and his staff operate with the energy of shock troops and the inspiration of pioneers. From makeshift offices in a white farmhouse they directed the construction of their plant and its first production of sodium. They have now moved into the last building to be erected—a crisp, functional administration building housing supervisory offices and a modern laboratory.

SOUVENIR

Result of this activity is metallic sodium, the silvery metal that grays on exposure to air. At National Distillers they have saved the first few ounces of sodium produced by the new plant. It's sealed in a pint-sized laboratory flask, kept in a safe, and shown to visitors. The flask is labeled, and the words on the label express pride of accomplishment. The label says: "$10 million worth of sodium"—sodium actually sells for less than 20 c. a lb., but these first few ounces have a sentimental value equal to the investment that produced them.

DIVERSE USES

Addition of this major producer of highly versatile sodium promises to expand further the Cleveland-Northeast Ohio economy. Commercial applications of sodium range from its use in production of tetraethyl lead, dyes, fatty acids, amines and sodium cyanide, peroxide and hydride to drugs and synthetic perfumes. The many uses of sodium in the metal industry make the new plant especially valuable in the area. Sodium is used in alloy formations with silver, gold, tin, mercury, cadmium, zinc and lead. It is used in removal of antimony and bismuth from lead and in the preparation of heavy metals. It is also used to lower the surface tension of metals in producing a tin-free bearing metal.

The nation's annual sodium requirements currently exceed 75,000 tons. With the increased availability of this versatile and reactive chemical, many new industrial applications have been developed, and many more are currently in the laboratory stage.

SITE ADVANTAGES

Occupying 65 acres, close to CEI's Ashtabula power plant, National Distillers enjoys a combination of vital location advantages as far as its three basic production needs are concerned: plenty of salt, plenty of water, plenty of dependable electric power. Raw salt is currently being shipped from Michigan via low-cost water transportation, but salt producers are exploring the possibilities of tapping salt deposits within a few miles of the plant.

HOW IT'S MADE

National Distillers produces its metallic sodium by electrolysis of fused sodium chloride. The raw salt is converted to refined brine, which is processed again to make carefully purified salt. The pure salt is then dried at high temperature and fed into the Downs cells by electric conveyor. Electric power is introduced to the operating cells at 5 kwh. per lb. of sodium. At an operating temperature of 500 deg. C. the sodium and chlorine separate and each is drawn out of the cell.

DOWNS CELL

Development of a commercially suitable cell for the electrolysis of fused

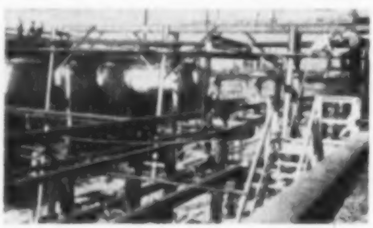
(Continued)

sodium chloride did not materialize until about thirty years after Castner's patent in 1888 on the electrolytic sodium hydroxide cell. Several cells were developed during this period, among these being the Acker cell in 1902, the Ashcroft cell in 1906 and the McNitt cell in 1917. The Downs cell, patented in 1921, was successful in solving many of the difficulties encountered by the other inventors. The Downs cell accounts for the greater part of the present sodium production, and should be ranked with the Hall aluminum cell and the Dow magnesium cell as one of the most successful fused-electrolytic cells ever developed.

The Downs cell consists of a sectional steel vessel lined with refractory and insulating brick. The graphite anode projects upward from the bottom of the cell and is attached to the electrical connections. The cathode is a cast steel cylindrical ring, supported by two projecting iron arms that extend through the sides of the cell to the electrical connections. Over the anode and submerged in the electrolyte, is a conical bell of iron or refractory for collecting the chlorine. Surrounding the lower edge of the bell is an inverted annular launder, also submerged, for collecting the sodium. Screens attached to the edges of this launder, and extending downward between the electrodes, serve to prevent the sodium from being carried away and recombining with the chlorine. A riser pipe attached to the top of the launder permits the sodium to flow continuously into an external receiver. The riser pipe extends far enough above the bath level so that the sodium, because of its low specific gravity, can overflow but the bath cannot. The riser pipe and the receiver also permit the sodium to cool before it is discharged. An opening in the cell cover is provided in order that the salt can be charged.

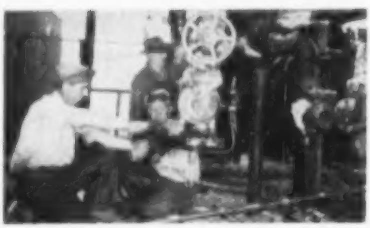
Demothballing Another Synthetic Rubber Plant . . .

TANKS



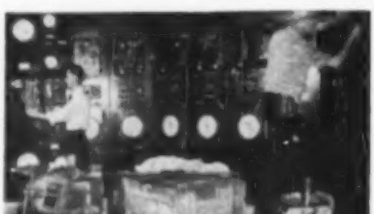
Workmen repair and clean butadiene tanks and pipes at Louisville, Ky., plant of Kentucky Synthetic Rubber Corp., now being reactivated. Tanks at left store butadiene coming from plant in background. Pipes carry it to reactors where the GR-S is made.

VALVES



The valves of a steam pressure reducing station are checked, cleaned and repaired. Plant, with an annual capacity of 30,000 tons, by the first of the year will be producing butadiene-styrene rubber for defense and civilian needs as it did in World War II.

INSTRUMENTS



Micromax is inspected and temperature controls are cleaned and calibrated. This is reactor instrument control room. There is one panel for each reactor, with temperature and pressure recorders and a pressure alarm system. Ten firms are to run plant jointly.

ELECTROLYTE

The electrolyte is a mixture of salt and calcium chloride that forms a eutectic containing 66.8 percent calcium chloride and melting at 505 deg. C. Use of this mixture with its lower melting point permits lower operating temperature, which reduces maintenance on the cell parts. Cell operating temperature is approximately 600 deg. C. The salt is very carefully purified and dried at a high temperature to remove as much moisture as possible before being fed to the cell.

METALLIC SODIUM

Metal deposited at the cathode is pure, except for calcium, which is dissolved in the sodium. The amount of calcium in the alloy is not known exactly, but calculations based on the calcium-sodium equilibrium diagram and thermodynamic data indicate a concentration of 3-4 percent at the eutectic composition. Solubility of calcium in sodium is 5.5 percent at 600 deg. C., and it decreases rapidly with falling temperature, becoming about 4 percent at 400 deg. C.; 2 percent at 200 deg. C.; and less than 0.01 percent at the melting point of sodium, which is 97.5 deg. C. During the cooling cycle in the riser pipe, an appreciable amount of calcium crystallizes out and, because of its higher density, falls back into contact with the electrolyte and reacts with it to reproduce the equilibrium alloy. Other methods can be used; for example, Hulse has patented a method in which calcium-containing alloy is brought into contact with solid salt, whereupon the calcium forms calcium chloride and sodium. The crude sodium is filtered at 105-110 deg. C. to reduce the calcium content below 0.04 percent and to separate small amounts of bath and oxides. Purity of the sodium as now marketed is above 99.9 percent, and the chlorine produced is pure enough to be liquefied and marketed.

CURRENT EFFICIENCY

The current efficiency of the cell is about 80-85 percent. Mantell gives the voltage as about 7. This corresponds to an energy consumption of 5 kwh. of a.c. power per lb. of sodium, after allowing for a 6-8 percent loss in converting from a.c. to d.c. power.

OUTPUT AND PRICE

With improved manufacturing methods and increased uses during the past 60 years, the price of sodium has dropped from \$2 per lb. to less than 20 c. per lb. Production of sodium from the Castner process attained a

(Continued)

peak of 15,000 tons per year in the middle 1920's, just prior to the use of sodium in the manufacture of tetraethyl lead. Postwar figures indicate that annual sodium requirements exceed 75,000 tons per year.

SHIPPING

Crude sodium is further refined and cast in ingots or bricks and packed in drums for shipping. Lots of 40 tons are shipped in special tank cars. The molten sodium is drawn by vacuum into tank cars, is allowed to cool and solidify, and is remelted before unloading. This is probably the only case in which a metal is shipped in such a manner. The low melting point (97.5 deg. C.), low specific gravity, high heat conductivity, and large-scale uses of sodium make this shipping technique feasible. Pipes that carry the molten sodium to waiting tank cars are kept at temperatures above sodium's melting point by batteries of efficient electric strip heaters built into the pipe wall.

CHLORINE

The byproduct, chlorine gas, is compressed and piped to the neighboring plant of Hooker-Detrex Corp., where it is used to make trichloroethylene.

New Naval Stores Plant Uses Olustee Process

Mississippi's first—and the nation's twenty-ninth—pine gum cleaning and distilling plant has begun operations in Wiggins, using processes developed by the U. S. Department of Agriculture at a field station of the Bureau of Agricultural & Industrial Chemistry in Olustee, Fla.

Robert Newton, president of the company, says this is the second plant in which his firm has applied the Olustee methods. The Newton Co. at its Lake City, Fla., plant has used these techniques for several years. So have most other central naval stores plants in the pine gum belt.

The processes include an improved procedure for cleaning crude pine gum to produce clean, brilliant rosin, and the use of steam distillation to obtain bright, sparkling turpentine of high quality and low acidity.

Present widespread use of the Olustee method of cleaning crude gum puts 90 percent of the gum rosin produced today in the three to four top grades, according to E. L. Patton, head of the Naval Stores Station. Almost the reverse was true before the method was patented in 1941, when most of the rosin fell in the seven lower grades.

Steam distillation, which has practically replaced fire stilling in the past two decades, permits greatly improved control operations in processing the gum, Patton says.

Freeze Drying Cuts Costs In Processing Pharmaceuticals

You can dry frozen materials such as blood plasma from 70 to 90 percent faster by feeding them penetrating "hot-shots" of electricity than you can by merely conducting heat to them, a University of Wisconsin student and his professor have shown in research studies they conducted in chemical engineering.

They found that freeze drying with radiant energy is more rapid than with conduction heating because of the penetration of radiation into product.

They found out, for example, that the freeze-drying capacity of an organic dye was increased by 74 percent by virtue of the penetrating effect of radiant energy.

The advantages of the reduction in drying time would be reflected in lower equipment costs and reduced operating costs for the freeze-drying process, they explained.

The Wisconsin experimenters who made the findings are W. H. Zamzow, who received both his bachelor's and master's degree in chemical engineering at the university, and W. R. Marshall, Jr., associate professor of chemical engineering. The work was done for the Wisconsin Engineering Experiment station and was partially supported by the Wisconsin Alumni Research Foundation. It was reported at a meeting of the American Institute of Chemical Engineers.

Medical products to which this freeze-drying process has been applied include blood plasma, blood fractions, streptomycin, albumin, vaccines, and hormones. Prior to the development of freeze drying, these products could not be obtained in dry form with the same high level of potency.

Neither freeze drying by radiant heat transfer nor by conduction heat transfer are new processes, but widespread industrial application of such drying methods on medical and food products occurred only during and since World War II, they reported.

Since freeze drying has come into greater industrial use, there have been questions in the minds of scientists and engineers as to the comparative effectiveness of freeze drying by conduction heating as against freeze drying with penetrating radiant energy.

In freeze drying, a material is dried in vacuum in its frozen state by reducing its water content as ice rather than by evaporating it as a liquid.

In freeze drying by conduction heating, the heat is conducted to the frozen material through a solid retaining medium heated by circulating liquids or gases. In freeze drying with radiant energy, heat penetrates in suitable wave bands right through the frozen product to reduce it to its lighter and less bulky state but still preserve its value and quality.

The Wisconsin scientists reported that in commercial practice the time of freeze drying streptomycin was cut from 48 hr. by conduction heating to 12 hr. by radiant heating, blood plasma fom 48 hr. to 14 hr., albumin from 48 to 3 hr., hormones from 24 to 2.4 hr., blood fractions from 84 to 12, and vaccines from 24 to 3 hr.

For some of these materials, reduction in drying time under radiant freeze drying may have been responsible for a higher level potency of the finished dried product, which was not obtainable by conduction freeze drying, the Wisconsin engineers reported.

National Lead Getting Pair Of New Contact Acid Plants

National Lead Co. has contracted for two new sulphuric acid plants. Chemical Construction Corp. has already broken ground on these projects.

One of the new plants will be located in St. Louis, Mo., and the other in Sayreville, N. J. Each will have a capacity in excess of 300 tons per day. The plants will be conventional contact units. Output of the new plants will be used to expand National Lead's production of titanium pigments.

Merck Adds Big Fermentation Unit at Cherokee Plant

One of the largest fermentation units in the country will be included in the facilities for antibiotic production now being built at the Cherokee plant of Merck & Co., Inc. The plant is located near Danville, Pa.

Four major buildings and several smaller structures will be included in the installation. In addition to the large fermentation unit, there will be a filtration and extraction building; a warehouse and laboratory unit; and a sterile techniques building. Austin Co. of New York City is the builder. Construction, to cost several million dollars, is expected to be completed next spring.

Merck officially took over the Cherokee plant from the Army August 1, after completing negotiations earlier this year for a 15-year lease and eventual purchase of the plant.

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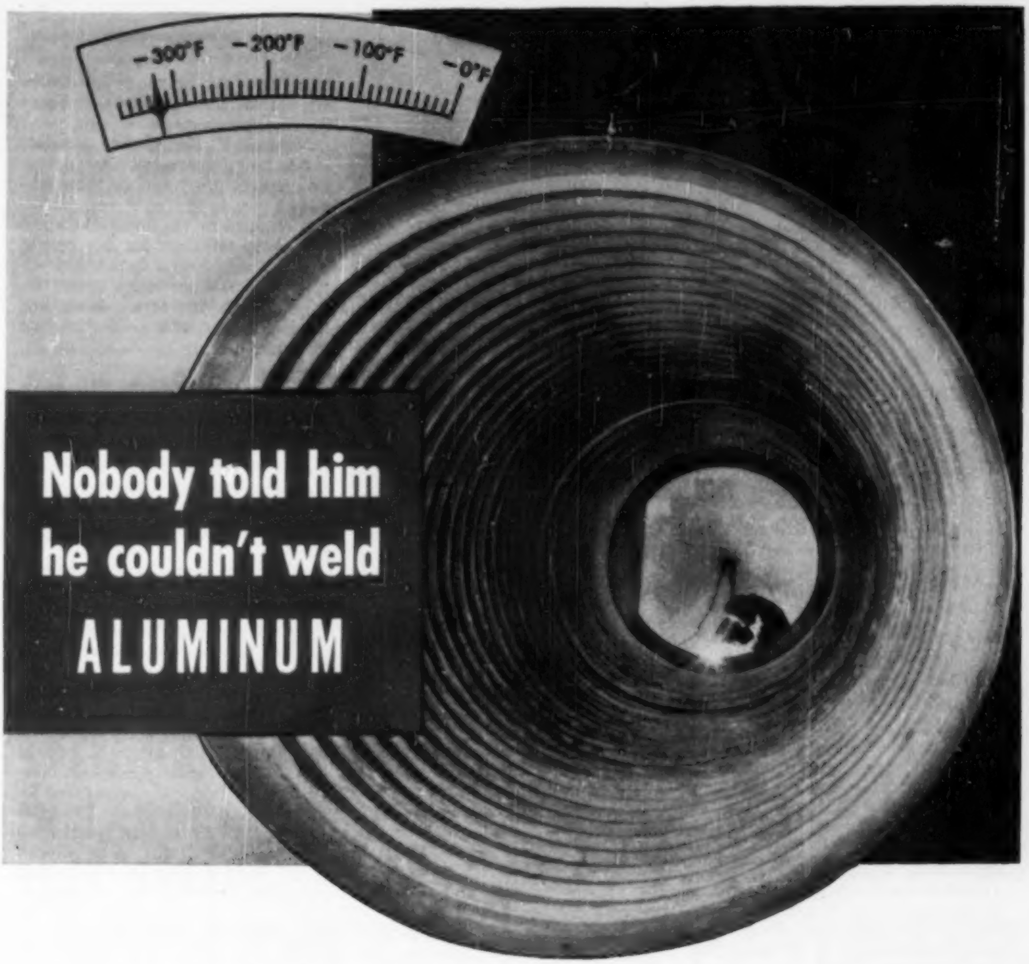

So he's welded 37 aluminum rings—7 feet in diameter—into this low-pressure oxygen plant, bubble cap tower of Alcoa Aluminum. And very nicely, too. Welding aluminum is no harder than welding other metals. Just follow recommended, simple procedures and you'll have smooth, tight joints every time. Gas, arc, resistance . . . aluminum takes them all.

But ease of welding is only one of the reasons you'll want aluminum for sub-zero process equipment. It costs 25 to 50% less than other suitable metals. Alcoa Aluminum gets stronger and tougher as temperatures drop. Shows no signs of embrittlement at temperatures down to −320°F and lower. Use of aluminum speeds fabrication, reduces maintenance and increases the efficiency of exchangers and expanders.

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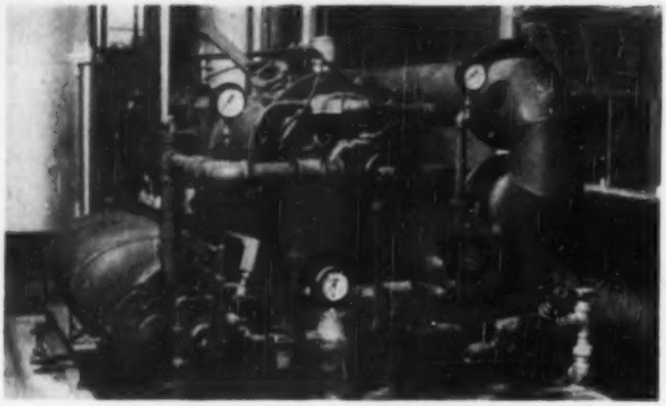

Installation of this Roots-Connersville inert gas generator and others like it in three solvent extraction plants of Central Soya Co., Inc., that use hexane enabled the company to reduce insurance policies from 500 to three and resulted in savings of approximately $6,000 per month on the insurance premiums that Central Soya pays for coverage.

Inert Gas Generator Enables Soybean Processor To Minimize Hazard and Cut Insurance Costs

Because they use large volumes of such flammable hydrocarbon solvents as hexane, solvent extraction plants carry heavy insurance at high premiums. With an eye on savings in insurance, Central Soya Co., Inc., of Fort Wayne, Ind., a leading operator in the soybean industry, has put into effect a broad protection program. Essence of the program is use of inert gas blown through the extraction system. Inert gas generators have been installed at the company's plants. As a result, Central Soya has been able to reduce from 500 to three the number of insurance policies covering its three modern soybean oil extraction plants.

Dollarwise, it has proved a sound investment, representing a saving of approximately $6,000 per month in insurance premiums, according to Central Soya officials.

The protection program is adaptable to most raw material processing in which inert gas may be used. The gas provides the safety factor.

With emphasis on inert gas generating equipment and sprinkler systems, fire walls and doors, ventilation and other safety measures, the Central Soya program has resulted in safer working conditions at the company's three processing plants for the production of soybean oil and byproducts, as well as livestock and poultry feeds. These soybean processing plants are located at Decatur, Ind., Marion, Ohio, and Gibson City, Ill.

The extraction process involves the use of large amounts of the flammable hydrocarbon solvent hexane in the extraction towers. The process separates the flaked bean into liquid soya oil and solid phases. Subsequent steps remove the hexane from the oil and also from the spent flakes in dryers, from which the solvent is condensed and recovered.

Central Soya's protection program is based on recommendations of the 96-year-old Fireman's Mutual Insurance Co., one of the largest industrial underwriters, which specializes in superior risk properties.

Coverage under the three insurance policies also provides for periodic variations in inventory, depending on raw materials, materials in process and finished inventory.

Central Soya installed a Roots-Connersville inert gas generator at each of the three plants. Costing approximately $5,000 plus installation, each generator is located in a building separate from the extraction tower itself. Inert oxygen-free gas is produced by the generator by the combustion of kerosene or fuel oil. The gas has a composition approximating that of flue gas; it contains close to 80 percent nitrogen, together with about 15-18 percent carbon dioxide. The inert gas is blown through the system as needed, both for shutdowns during purging operations and when the tower again is started up for the extraction function. Thus the hexane is introduced into an inert atmosphere well below the combustion range.

Norman F. Kruse, vice president and technical director of Central Soya Co., reports, "Not only do these generators give us the additional protection required by the underwriters and desired by ourselves for our people, but they reduce to a considerable extent the downtime when towers are purged, every five or six weeks, and thus add considerable productive time for the entire plant."

Koppers Reactivating Units At Kobuta to Make Butadiene

Koppers Co., Inc., expected to put the first unit of the government-owned butadiene plant at Kobuta, Pa., into operation late in November. A second unit is slated to be running early in January.

A force of approximately 150 construction men have been working at top speed to reactivate the two units of the plant. Reactivation was ordered by RFC's Office of Rubber Reserve when it became apparent that more butadiene was needed for the nation's synthetic rubber program.

When both units are in operation, approximately 80 men will be required to keep them running on a round-the-clock basis. Principal raw material for the making of butadiene is 190-proof alcohol. The government is arranging for supplies of alcohol to be shipped to the Kobuta plant, and has called upon various distillers of the nation to supply it in large quantities. One of these, Park & Tilford Distillers Corp., plans to produce 300,000 gal. of the 190-proof alcohol during November and December for shipment to Kobuta.

BIG BINGE

The 300,000 gal., however, is just a small nip compared with the quantity that will be required to keep the two units operating. Each of the units will use between 70,000 and 80,000 gal. of ethyl alcohol per day. Thus the amount needed each month will be in the neighborhood of 4.5 million gallons.

When the two units are operating at capacity, they are expected to produce about 10 million pounds of butadiene monthly.

The government's butadiene plant at Kobuta is adjacent to the Koppers styrene plant, and was built during World War II when the supply of natural rubber became short. It was one of the largest producers of butadiene in the country. Following the

(Continued)

NEWS, cont. . .

war, Koppers purchased the styrene units from the government and since has produced styrene and polystyrene, while maintaining the butadiene units in a standby condition for the government.

Two additional butadiene units at the government-owned Kobuta plant have not yet been ordered reactivated.

Stone Tells ADMA How Pfizer Introduces New Chemicals

What happens in the two weeks to 12 months between the discovery of a new chemical and its mass marketing? That's the question George B. Stone, coordinator of new product development for Chas. Pfizer & Co., Inc., tried to answer for members of the American Drug Manufacturers Association at their recent Hot Springs, Va., meeting.

To the ADMA's Pharmaceutical Development Committee, Stone recounted, as an example, the story of how the work of six groups of researchers was coordinated to solve the complex problems Pfizer had to face before the company could put the new vitamin B_{12} on the market.

Once a new chemical has been discovered, Stone explained, the next task is predicting the forms in which it can be useful. Scientists must sit down and plot on paper all possible uses and formulations for the new product. In this, as in many fields, prophesying is difficult. In the case of vitamin B_{12}, he said Pfizer's "paper study" forecast a compatibility study list of 25 compounds. "But two months after our product was introduced, the list had grown to somewhere near 60. Customer inquiries accounted for the increase."

TECHNICAL EVALUATION

At the center of the preliminary work on new product development is the technical service department, Stone told the pharmaceutical manufacturers. Working with it are the technical information group, market researchers, chemists and biochemists, pharmacologists and clinical researchers. All of these groups contribute to the paper study. The time goal is set by the sales department.

Outlined in the paper study is an evaluation of the possible formulations for the new pharmaceutical. Types of dosage forms and processing, as well as other pharmaceuticals with which the new compound may be admixed are also blocked out in this early stage.

APPLICATION RESEARCH

With the paper study done, the amount of application research needed

can be figured out and an approach designed for the introduction and sales development of the product. Stone said that these predictions are by no means always fulfilled, for changes in the manufacturing process will often alter the product's final form. "In that case," he said, "application research work must be begun all over again."

BULLETINS

Technical information bulletins for the advertising and promotion departments and for customer use are the next job. When the pharmaceutical industry becomes aware of the new product, a "deluge of inquiries" floods in. *(Continued)*

CONVENTION CALENDAR

American Association for the Advancement of Science, Chemistry Section, Allerton Hotel, Cleveland, December 26-30.

Division of Industrial & Engineering Chemistry, American Chemical Society, Christmas symposium, Johns Hopkins, Baltimore, December 28-29.

Plant Maintenance Show, Auditorium, Cleveland, January 15-18.

Society of Plastics Engineers, national technical conference, Statler Hotel, New York, January 18-20.

American Society of Heating & Ventilating Engineers, 57th annual meeting and 10th Heating & Ventilating Exposition, Commercial Museum, Philadelphia, January 22-26.

Instrument Society of America, New York Section, Process Control, Hotel New Yorker, January 26-27.

Society of the Plastics Industry, Reinforced Plastics Division meeting, Sixth annual technical session, Edgewater Beach Hotel, Chicago, February 28-March 2.

Pittsburgh Conference on Analytical Chemistry & Applied Spectroscopy, William Penn Hotel, Pittsburgh, Pa., March 5-7.

American Society for Testing Materials, spring meeting and committee week, Cincinnati, March 5-9.

Drug, Chemical & Allied Trades Section, New York Board of Trade, 25th annual dinner, Waldorf-Astoria Hotel, New York, March 8.

American Institute of Chemical Engineers, regional meeting, Greenbrier Hotel, White Sulphur Springs, Va., March 11-14.

National Association of Corrosion Engineers, conference and exhibition, Statler Hotel, New York, March 13-16.

Seventh Western Metal Show, American Society for Metals, Civic Auditorium, Oakland, Calif., March 19-23.

American Wood-Preservers' Association, annual meeting, Stevens Hotel, Chicago, April 24-26.

Materials Handling Exposition, International Amphitheatre, Chicago, April 30-May 4.

"At this point," warned Stone, "you begin to learn just how complete and effective your original paper study really was. It is impossible in the beginning to envision all the potential uses and formulations for the new product and these inquiries generally confirm this fact."

FIELD WORK

Technical men go into the field to discuss the new product with the customers. This busy period of application research in the laboratory, combined with field work and technical writing, usually extends some three to nine months. "Whether the work proceeds smoothly or not is inherent in the new product being developed and introduced," said Stone.

LAST PHASE

The final stage in developing a new medicinal comes after the technical requests from the trade have become routine and is concerned with very special problems. Formulation and dosage work goes on, and research on improving the utility and diversity of application of the new product are stressed. Final technical bulletins are compiled for the sales department.

Stone cautioned his audience that what seems to be a "somewhat simple and standardized routine is greatly complicated by the fact that we are never concerned with just one product at any one time."

Hooker Adds Chlorine-Caustic Capacity at Tacoma Plant

New facilities for the increased production of caustic soda and chlorine at the Tacoma, Wash., plant of Hooker Electrochemical Co. have been completed. Two circuits of the new Type S-3 electrolytic cells, which have far greater capacity than the old cells replaced, have been installed.

Besides the new cells, extensive additions have been made for treating and handling brine, for purifying and evaporating caustic soda, and liquefying chlorine. Triple-effect pans have been installed for caustic evaporation and a new boiler supplies the added steam requirements.

Other facilities completed include a new cell construction and renewal building, additional storage tanks, enlarged water supply system, expanded dock facilities, and other facilities to handle the increased production.

Increased production of caustic soda and chlorine is largely to meet the growing requirements of pulp mills in the Pacific Northwest. Other industries served in the West Coast area include petroleum, soap, mining, food, plywood, water treatment and chemicals.

Spencer's Kentucky Plant Now Turning Out Ammonia

A new source of ammonia for fertilizer and industrial use was opened recently when Spencer Chemical Co.'s Henderson Works, Henderson, Ky., began production. Its rated annual capacity: 68,000 tons of ammonia.

Spencer purchased the Henderson plant from the government last May 1, at the same time leasing nitric acid facilities at Charlestown, Ind. A rehabilitation program, representing an estimated investment of $3 million, was immediately started at both plants.

The Charlestown Works will be used to manufacture ammoniating solutions for mixed fertilizers. Ammonia for the manufacture of these solutions will come from Henderson. Operations were slated to begin during the first week in December.

Spencer, with headquarters in Kansas City, Mo., and a southeastern office in Atlanta, Ga., operates plants at Pittsburg, Kan.; Parsons, Kan.; and Chicago, Ill.; in addition to Henderson and Charlestown.

Polyester Resins Find Wide Field of Applications

During World War II, low-pressure polyester resins were taken directly from the laboratory and put to use in wing liners, Doron and radomes. In the fall of 1946, when war contracts were being terminated, there were very few civilian uses known for polyester resins, with the exception of paper-base decorative laminates. Yet, it is easy to understand why these new resins appear so promising.

They are the only thermosetting materials that have a range of properties extending from a highly rigid, brittle type resin to flexible materials that are similar in some ways to vinyl compounds. All of the resin reacts without the necessity of removing solvent. They are fluid and easily handled because of the wide range of viscosities available. Special types of resins are available for fire resistance; crystalline waxlike resins are available for use as hot melts.

Beginning with some of the wartime developments of low-pressure polyester resins, Dr. J. D. Robinson of American Cyanamid Co. recently outlined to members of the Society of Plastic Engineers meeting at the Hotel Shelburne in Manhattan the characteristics of these resins, methods used in handling them, and their application.

Polyester resins cure quickly. They are exothermic in their reactions, which means that the power necessary to cure them is reduced. They are quite fluid and capable of flowing rapidly, can be handled and formed with very low pressures.

PROBLEMS

Two problems involved in the use of low-pressure polyester resins were discussed by Robinson. They are the fact that there is shrinkage in passing from the liquid, monomeric stage to the rigid, cured condition, and the control of exothermic reaction to prevent the resins reacting so vigorously that the quality of the plastic part is damaged. These problems are being worked out and more knowledge is being obtained daily.

Inert mineral fillers have been found useful in correcting some of the problems that are met with in the industry. Such things as boat hulls, tote boxes, trays, instrument cases, skylight panels, housings for vaporizers, sterilizers, lamp shades and mannequins are examples of products now being produced from polyester and glass mat. Paper-base laminates, made continuously on sheets, are used in many places where decorative surfaces of good abrasion resistance is indicated.

OTHER USES

Some resins are being used for industrial castings to make such things as electrical capacitators and fishing rods. Electrical instruments are potted in polyester resins. Armatures for electric motors, signal devices for traffic lights are other examples of the usefulness of these resins in the electrical field. In addition to surfacing paper-base laminates, polyesters are also used for surfacing masonite, plywood and similar structural board.

FABRICATION

In discussing methods of fabrication, Dr. Robinson used polyester resin and glass mat as an example. Early work was done by laying the mat, saturated with resin, on a plaster or wood mold and covered with a separator sheet and a rubber blanket. The pressure was applied by evacuating the system and cure was accomplished by heating in an oven.

The next step was the use of matched metal dies or combinations of a metal mold and the application of fluid pressure from rubber bags or other similar sources. More recently, the trend has been to matched metal

(Continued)

molding with cutoff rings designed to give positive pressure on the molded part during the cure operation. In this way, pressure is applied on the liquid resin rather than on the glass mat fibers and parts with good surfaces have been developed.

GROWTH

In conclusion, Dr. Robinson explained that polyester low-pressure resins have experienced three stages in their growth: the period of experimentation and early development for military uses; the postwar period when they were applied to many impractical ventures; and the current period of steady and ever increasing acceptance and use, because of their outstanding performance in many economical products.

New Toledo Unit to Produce Alkyd Plastic Compounds

Construction of a major new plant addition for the production of alkyd plastic molding compounds has been announced by the Plaskon Division of Libbey-Owens-Ford Glass Co. The plant addition will be erected on a site at Plaskon's principal manufacturing location near Toledo, Ohio. The new capacity will be in production by March 1951.

Plaskon Alkyd molding material was announced in 1948 and its use by plastic molders and users of molded parts has increased steadily. It can be molded into finished parts at higher speeds and at much lower molding pressures than other plastics. Hence it is adaptable for use on high-speed less-expensive molding machines, several of which have been developed specifically for the purpose by machinery manufacturers.

The material's electrical properties and dimensional stability have resulted in its use in applications where plastic materials were previously unsuited. Typical uses for molded Plaskon Alkyd are radar components, television tuners, motor control devices, automotive and aircraft ignition parts, and high-precision molded parts.

Boyer of Esso Standard Becomes AEC Manager

An experienced management executive from the petroleum industry has agreed to take over the controversial reins of the nation's atomic energy program.

Marion W. Boyer, vice president in charge of manufacturing of the Esso Standard Oil Co., has been named the

(Continued)

News, cont. . .

Atomic Energy Commission's general manager. AEC's first general manager, Carroll Wilson, resigned August 15 after a dispute with Commission Chairman Gordon Dean. Wilson complained that the Commission was becoming a "management committee" instead of a policy-making body. Carleton Shugg, who has been serving as acting general manager since Wilson left, will resume his post as deputy general manager.

A native of Indiana and a graduate of the Massachusetts Institute of Technology, Boyer joined Esso Standard in 1927 as a chemical engineer. With the company, he has been in charge of the Baton Rouge, La., refineries where major research developments have been achieved.

Boyer, 49, was named vice president and director in charge of Louisiana operations in 1945. Last year he was moved to New York to take charge of all Esso Standard's manufacturing operations.

Jefferson Building Unit To Turn Out Trio of Amines

A new unit for the production of monoethanolamine, diethanolamine and triethanolamine is under construction at the Port Neches, Tex., plant of Jefferson Chemical Co. The Houston office of C. F. Braun has the contract for building the unit, which is slated for completion late in 1951.

The trio of amines will provide the base for the production of additional plastics and synthetic detergents in Jefferson's enlarged Port Neches plant.

It was in January 1948 that this plant first started operating. Later it was enlarged in order to produce ethylene glycol.

Anthraquinone production is being stepped up by American Cyanamid Co. Additional facilities for its manufacture are being constructed at the Bound Brook, N. J., plant of the Calco Chemical Division. Demand for vat-dyed textiles is reflected in the increased use of vat dyes and other derivatives of anthraquinone. Construction should be completed by early spring.

Chlorine-caustic production at the Niagara Falls plant of Stauffer Chemical Co. will be nearly doubled when the current expansion is completed early in 1951. In addition, the metal chlorides plant is being revamped for greater production and efficiency. Added carbon tetrachloride capacity is already in operation.

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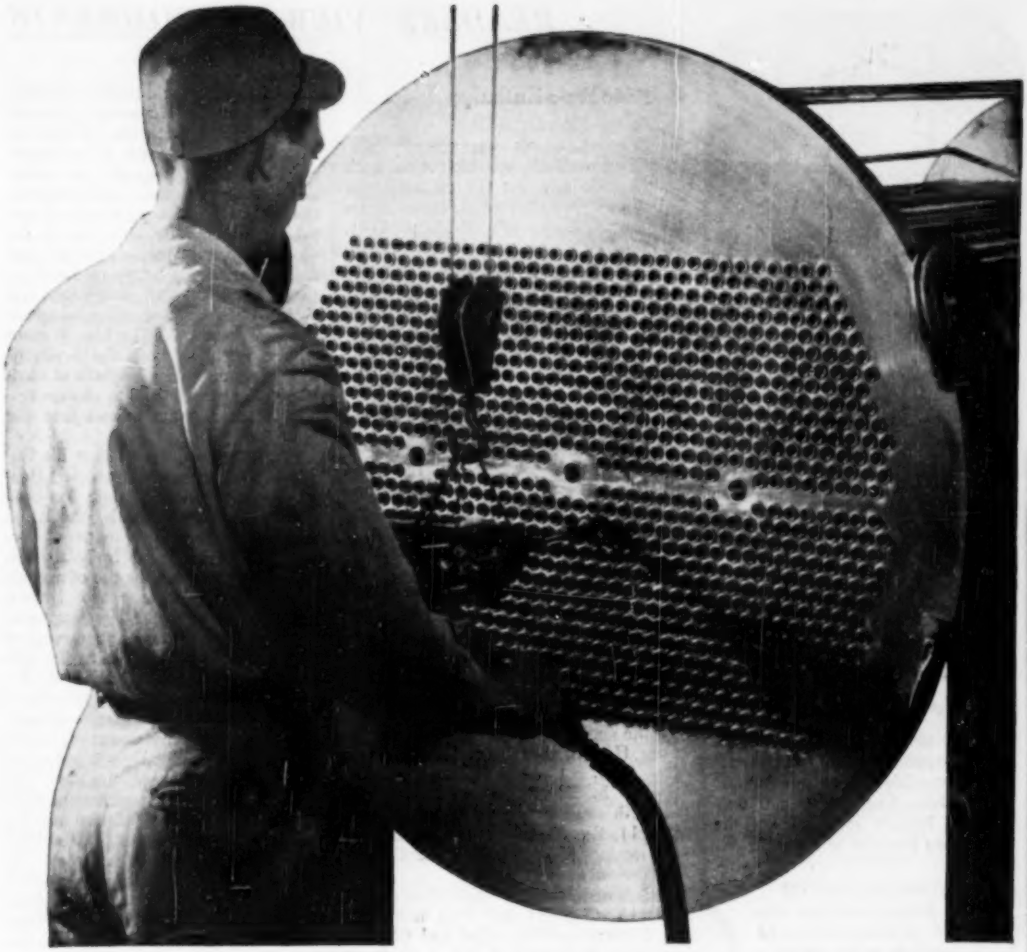

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READERS' VIEWS & COMMENTS

Slide Rule Enthalpy

To the Editor:

Sir:—Eckhardt has recently presented methods, suitable for use with the slide rule, for the estimation of various properties of saturated steam (*Chem. Eng.*, July 1950, p. 119). Among them were two rather cumbersome formulas based on the Henning formula for the total heat of saturated steam. The following are also based on the Henning formula but are better adapted for slide rule calculation:

Total heat of saturated steam, Btu. per lb:

$$h_g = 1{,}062 + 0.42t \qquad (1)$$

$$h_g = 1{,}044 + 0.63t - 6(t/100)^2 \qquad (1a)$$

Range of Eq. (1) is 32 — 212 deg. F. and range of Eq. (1a) is 212 — 464 deg. F. Accuracy of these equations is better than 0.22 percent.

Values of h_g for temperatures up to 500 deg. F. can be obtained with the same degree of accuracy by calculating values above 464 at a temperature as far below 464 as the temperature in question is above 464.

Latent heat of evaporation of water:

$$h_{fg} = 1{,}094 - 0.58t \qquad (2)$$

$$h_{fg} = 1{,}083 - 0.40t - 6(t/100)^2 \qquad (2a)$$

Temperature ranges and accuracy are the same for Eqs. (2) as for Eqs. (1).

Heat of the liquid:

$$h_f = t - 32 \qquad (3)$$

$$h_f = 1.03t - 39 \qquad (3a)$$

with same temperature ranges as Eqs. (1). Eq. (3) is essentially exact and accuracy of Eq. (3a) is better than 1.3 percent.

The method of application of Eqs. (1), (2), (3) and (3a) is straightforward and Eqs. (1a) and (2a) can normally be solved with a single setting of the slide and two settings of the cursor.

Example 1—To find the total heat of saturated steam at 400 deg. F. Set R.H. index of C to 400 on D, under 0.63 on C read 252 on D, and over 60 on B read 96 on A. Then

$$h_g = 1{,}044 - 252 - 96$$
$$= 1{,}200 \text{ Btu. per lb.}$$

Example 2—To find the latent heat of evaporation of water at 400 deg. F. Set R.H. index of C to 400 on D, under 0.4 on C read 160 on D and over 60 on B read 96 on A. Then

$$h_{fg} = 1{,}083 - 160 - 96$$
$$= 827 \text{ Btu. per lb.}$$

F. A. WATSON

British Tar Products Ltd., Cadishead

Strike the Happy Medium

To the Editor:

Sir:—The international reaction to my article gratifies me and I am pleased to have the disclosure of additional equations. However, I can not agree altogether with the opinions of Mr. Watson that some of the equations which he proposes are better adapted for slide rule computations than the equations presented in the subject paper. The objective in devising empirical equations for physical data is to strike a happy medium between accuracy and simplicity, and at the same time cover an adequate range of values. While Mr. Watson steered safely between the Scylla of inaccuracy and the Charybdis of complexity, he was obliged to change vessels at sea in order to complete the voyage.

There is no question that his Eq (1) is simpler than the modified Henning equation, is valid over less than half the range covered by the latter. Obviously, the employment of two equations (1) & (1a) by Watson is more involved than the use of a single equation for the entire range. Indeed, the complexity of the Henning equation is only a matter of appearance or algebraic theory, for, virtually, this equation is simpler than Watson's Eq. (1a). Practically when employing a log-log slide rule, the solution of equations involving any power exponents is no more difficult than it is for any other functional scale of a slide rule. An analysis of the operations required to solve Eq. (1a) of Watson and Eq. (20) of Henning shows that the latter equation is the easier to solve. The former equation requires a total of six operations: two slide rule manipulations involving a total of four settings, plus an addition and a subtraction. The latter equation requires a total of only five operations: a subtraction followed by two slide rule manipulations likewise involving four settings. It is worth noting that the subtraction operation of the Henning equation is simpler than the corresponding operations of the Watson equation. Similar criticism applies to the comparison of the equations for the enthalpy of evaporation.

Naturally, all the equations proposed by Mr. Watson are worth including in a compilation on this subject, since circumstances and personal preferences would alter cases. Obviously the two linear equations for the lower range are indicated for applications such as air conditioning and low temperature drying operations. Mr. Watson has, in typical English character, understated the precision of his equations. The maximum error is indeed less than 0.22 percent, since I found only a maximum error of less

than 0.12 percent from over 25 test calculations with Eqs. (1) and (1a).

It may be in order here to indicate that the nominal error for a single operation of a 10-in. slide rule is on the order of about 0.1 percent. In practical operation, due to the rounding off of most of the scale readings to only three figures, the error may be as high as about 0.25 percent.

The slide rule is a precision instrument, whereas an accuracy of 1 percent is adequate for almost all practical engineering applications; indeed, original data may often be uncertain by as much as 10 percent, if not more. In devising empirical equations for physical data, one must be aware that with each increase in the order of precision, the number of terms required increases cumulatively at an accelerated rate.

The value of 464 deg. F. given by Watson for the temperature at which the enthalpy of saturated steam is a maximum appears to be an error, possibly of typing or by the use of an obsolete steam table. The enthalpy reaches a maximum value of 1,205.0 at about 455 deg. F. (In my paper I gave this temperature as 454 deg. F.)

One objective for publishing the subject paper was to elicit responses such as from Mr. Watson in order to secure a collection of equations for obtaining physical data by means of a common slide rule. The Power formula, Eq. (21), is not the preferred type: perhaps some reader can devise a still better equation which would be valid for the widest range of values. The Davis solution for hydraulic friction factors illustrates the ideal type of slide rule solution, both as to form and practical application. I look forward to the publication of more such equations or slide rule solutions.

Henry Eckhardt

Industrial Consultant
Bayside, N. Y.

Charter Member

To the Editor:

Sir:—I think there has been some question as to who is *Chemical Engineering's* oldest subscriber.

Unless someone else has subscribed continuously since the first number (September 1902) I am your oldest. I have not only subscribed from the start but I had all numbers, from the first one to 1935, bound, and I donated these to the Royal Military College at Kingston, Ont., where they were put in the library. My son-in-law, the late Gen. H. H. Matthews, was Commandant at that time. I have long intended to let you know about this.

Ernest A. LeSueur

Ottawa, Ontario

District 50 Pension Plan—I

To the Editor:

Sir:—I refer to the article "Is This the Small Company's Answer to the Pension Problem" by P. F. Broderick in your August issue.

Both you in your preamble and Mr. Broderick in his text are careful to qualify the plan outlined as unsuited for "blind adoption" by small employers. I believe that these warnings will be too casually bypassed and that the nature of the limitations of the plan will not immediately be revealed since one of the features appears to be the avoidance of actuarial valuations.

The article emphasizes the linkage of the employer contribution to payroll so that both fluctuate together. The growing right to the pension, however, does not fluctuate so long as the employee has any attachment to his job. Hence, his service increment grows even though he is on short-time or lay-off and the real cost of the pension grows similarly without the fluctuation. As a general rule, no actuarial cost balance is ever obtained for a flat pension benefit by blindly relating the contributions to percent of payroll, or cents-per-hours, or so much per unit of production, or x percent of the profits, etc.

We must assume therefore that an actuarial imbalance exists in the outlined plan.

Where, then, does the plan supply the "rubber" needed to compensate for its actuarial imbalance? Apparently it is in the concept that retired employees will get pensions only commensurate with what is in the fund, namely, that the $100 a month may only be a legend. If the fund runs low, it is not at all clear how the pensions would be reduced below $100 a month, that is, how the pro rata share would be computed. In any event, it appears that the retired employees (and those nearing retirement at any time) might well have a very indefinite benefit to look forward to.

One of the purposes of a pension plan is to give reasonable assurance to employees (especially retired employees) that the benefits mentioned in the plan will emerge when the time comes; this assurance would not be present under the instant plan. Another function of a pension plan is to effectuate retirements as needed (for the good of all, whether by option of employee or employer). In the instant plan, if the benefit level falls, this function would hardly be applicable from a practical standpoint. Even under a pay-as-you-go system where

(Continued)


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the employer undertakes to meet pensions as they become due, there might be more definiteness than under the literal wording of the instant plan. Actually, any responsible employer under the instant plan would probably, if the trust fund ran low, be morally forced into a pay-as-you-go supplementation of the reduced pension.

The author cites a definite advantage in the elimination of past funding. I believe this is a mythical advantage since any plan which conditions the size of the benefit on service rendered prior to the plan's effective date is bringing in past funding whether he knows it or not.

Another point, it seems to me a hidden liability has been written into the plan when an employee must last through to age 65 in order to get a pension except if he becomes disabled (and apparently the plan is loose here), so as to prevent his employment "in any occupation in the company's operation." The intent is that an employee quitting or discharged before 65 would lose everything and yet, there always is the loophole that he can save everything if he can mancuver himself into that peculiarly flexible penumbra of "disability," seemingly not too difficult as age 65 approaches.

I have the feeling that the plan outlined is greatly over-simplified and dangerously reassuring. To my mind, the small employer's pension problem should be just as scientifically handled as that of the large employer. The cost problems are similar; if the large employer has a lot of old-timers—and vice versa. It is the same thing for the small employer. The difference is that the small employer's costs, if set up on certain bases, could fluctuate considerably more than the large employer's. Sometimes, to avoid this gamble, small employers stabilize the funding through an insured method or through a trust fund structure, either of which can be arranged to emphasize the sinking-fund, or "savings-bank," concept in contrast to taking advance discounts for the variable turnover and mortality potentialities of small groups.

I believe there is a further germane comment on the plan as outlined in the article. As far as I know, the Bureau of Internal Revenue has not yet approved (or disapproved) as "qualified" plans, those arrangements which merely set up a scheme of benefits and unrelated (actuarially) schedule of contributions. Any employer would want to make sure that his 3

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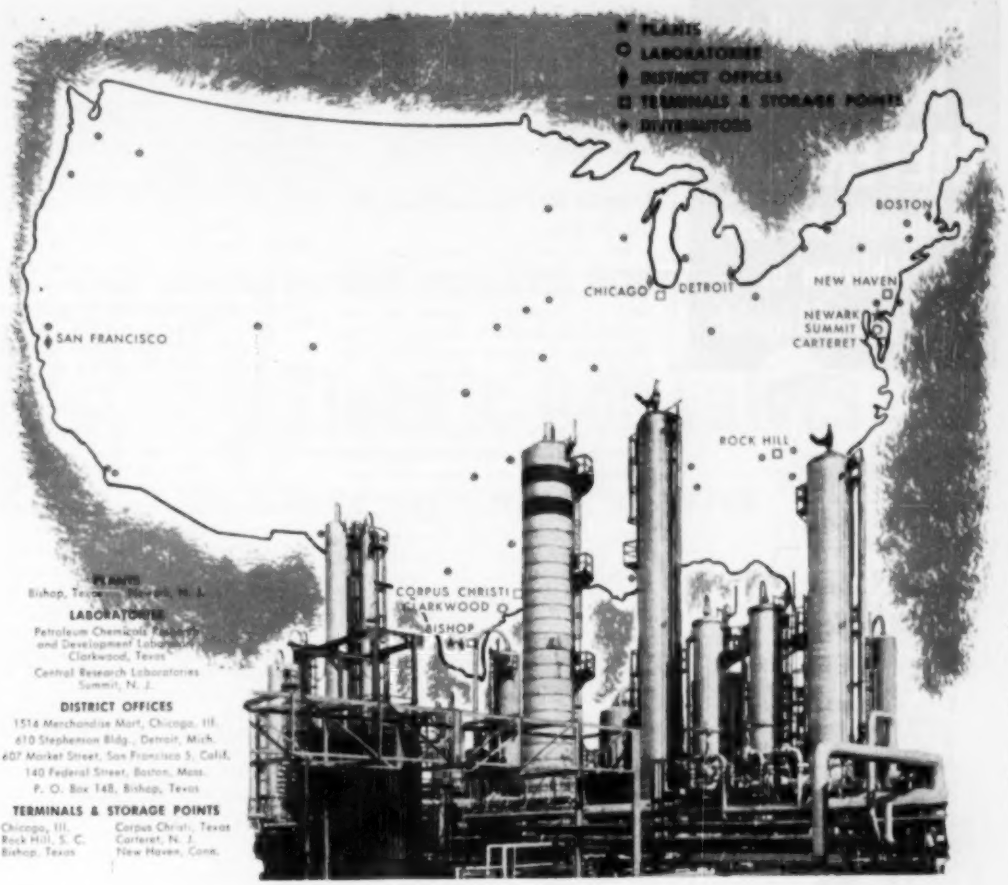

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District 50 Pension Plan—II

To the Editor:

Sir:—In reading the article [on pensions by Broderick] several thoughts came to mind which to me seem to have an important bearing on the matter, and should be brought to the attention of anyone considering the adoption of this particular pension plan.

As regards payments and benefits note how the words "sufficient funds" are repeated. It will not help labor relations to tell employees what pension they may expect to receive when it is realized right at the start that the funds contributed by the employer will be insufficient to maintain the proposed payments. The basic question is "Will there be sufficient funds?"

Suppose the employer does contribute regularly 3 percent of his payroll. Was this percentage actuarially computed to provide the benefits to fit his own case? If it is inadequate, sooner or later it will become abundantly clear that either the contributions must be increased or the benefits cut.

Then, who will be blamed if the funds in trust are insufficient to provide the benefits in full, especially if an independent actuarial audit should indicate that at the very inception of the plan it was headed for ultimate insolvency? Reduction in employee benefits is difficult at best; under the circumstances described, it would be almost impossible. There can be only one answer. The company would have to increase its contributions in order to continue payments of the pensions already agreed upon.

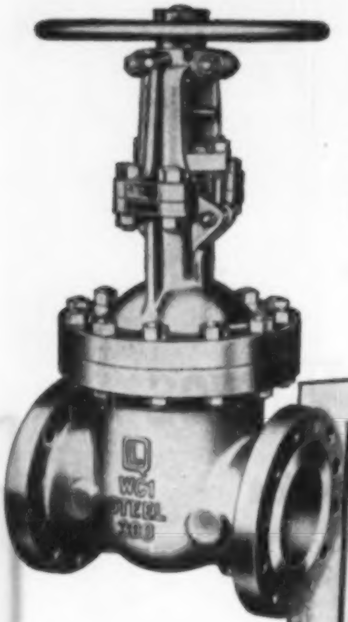
However, let us see what an actuarial determination of cost indicates as the proper contribution which should be made for this type of plan. In the table shown below, actual cases have been taken and the District 50 pension plan cost developed for them. For convenience, not only the number of employees involved in the calculations has been indicated but also the average compensation, average attained age at the present time, average age of entry into employment and average length of past service.

The table shows that even were no past service costs to be liquidated, the normal cost alone of the District 50 plan would run substantially in excess of the 3 percent of payroll contribution. However, past service costs are involved since the normal cost was not contributed in prior years. The table below shows that if past service costs were to be liquidated over a 20-yr. period, annual cost of the District 50 plan would approximate 10-15 percent of payroll. The actuarial factors used in arriving at the proper amount of contribution assume retirement at age 65, interest earnings on the fund at the rate of 2½ percent and conservative, but reasonable, factors for mortality, turnover and disability. The conclusion is inescapable, the program is not actuarially sound.

David G. Stone
Newark, N. J.

What would the District 50 pension really cost?

Company	A	B	C	D	E	F	G	H	I	J
Number of Hourly employees in the group	1,080	4,105	1,044	2,081	343	239	1,017	3,920	216	304
Annual payroll	$4,321,507	$10,550,617	$8,745,000	$6,332,473	$1,012,074	$627,869	$3,008,040	$11,554,216	$640,880	$912,140
Average annual compensation	$2,572	$2,572	$3,470	$3,042	$2,950	$2,627	$2,955	$3,024	$2,080	$2,577
Average present age	36.0	37.6	41.8	42.9	42.0	38.8	44.3	47.3	40.1	44.3
Average age of employment	27.0	28.6	33.7	30.8	30.5	32.4	28.4	34.0	30.0	31.4
Average years of past service	9.0	9.0	8.1	12.1	11.5	6.4	15.9	13.3	10.1	12.9
Normal cost	$217,157	$564,936	$500,343	$337,906	$58,668	$42,281	$142,522	$766,399	$49,928	$61,543
Percent of payroll	5.03%	5.35%	5.47%	5.34%	5.80%	6.73%	4.74%	6.47%	5.90%	6.75%
Normal cost plus 20-yr. amortization of past service	$430,084	$1,141,330	$866,302	$818,086	$126,468	$85,053	$392,723	$1,726,008	$101,380	$138,651
Percent of payroll	9.96%	10.81%	9.99%	12.94%	12.49%	10.93%	13.07%	14.98%	11.97%	15.22%



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RICHARD L. DEMMERLE, *Associate Editor*

Pith, Pap, or Purple Passion?

. . . Prelude to a Press Release

Every morning hundreds of eager press releases dance across the editorial desks of the nation's industrial publications. Each puts on its best smile for the casting director, the editor. Each believes it is entitled to top billing in the next production. Some try to achieve it by bluff, others by doggedness and still others by coquetry. But the real able "headliners" among press releases are limited in number. Why?

The answer is simple. In the midst of a public relations minded era a lot of the people who write releases and think they are doing a proficient job, have forgotten or never learned that the basic purpose of the news releases is the transmission of information to the press. By so doing they are neglecting the most economical and fundamental instrument of their profession.

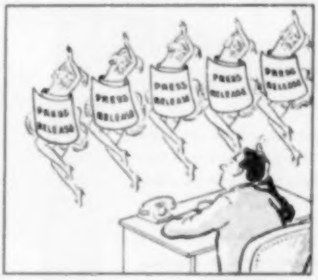
To an editor the well composed and directed release is more welcome than a free lunch. It is the source around which he can build his column, his page or his publication. Fortunately a comfortable percentage of the releases received help him do his job better and more easily, which in the last analysis is the criterion on which things are judged by any individual. But the mailbags keep tumbling into editorial offices with their quota of stories wearied by reuse and bloated with factual malnutrition.

Well, what is a good release? How should it be prepared and to whom should it be directed?

Before these questions are answered, however, the problem of creating a favorable atmosphere for the instigation, writing and reception of an industrial news release must be considered. From the point of view of the press relations man this can be resolved in terms of three knows:

1. Know the company, its products and problems
2. Know the publications in the field
3. Know the editors and their needs

The first of the above "knows" is pretty obvious and yet it is surprising to find that many PR people don't



know it. From the sound of some of the press releases an industrial editor receives it is safe to assume that thousands of new product and new equipment releases are written each year sight unseen. This type of release may contain a new product's name spelled in three different ways or confer three different titles upon the company official who announced it. Needless to say this is the kind of "news" that would evoke an editorial fit to print.

If an editor is able to spot the trace of a good story in such a dish-rag he will invariably go back to its writer for additional information. More times than not he will find that the release was a mirror of the ignorance of its author, who is unfamiliar with the product and even unsure of what division of the company developed or will manufacture it.

Sometimes of course, there are legitimate reasons for a company to withhold certain details about a new development or a management decision. An indiscreet revelation might endanger a patent position or a labor situation. In such cases a hearty "Sorry, for so and so reason we can't give you that information just yet," is enough. How much better an answer this is than the hazy "Gee, I wouldn't know how to get that dope for you," or the belligerent "what do you have to know that for?"

There is no doubt that the PR man who can write and talk authoritatively about his company's human, financial or technical activities commands a good deal more respect and cooperation from the industrial press, than the windy operator who says nothing and writes less. This of course presumes a management that is wise enough to take its ambassador to the press into its confidence. It also presumes that the "ambassador" is willing to learn about the organzation and principal industry of the "country" he represents.

KNOW THE PUBLICATIONS

But a knowledge of his company's activities is only one string in the bow of the efficient public relations man. To score a hit with his press release arrow he must know the shape and position of his target or targets. A dozen well directed meaty releases can accomplish much more than a gross of the pappy variety directed toward anything and everything that is published. The same company that will carefully weigh the virtues of buying advertising space in one magazine over another in the same field will indiscriminately spend its press relations substance trying to crash into all types of publications in all fields.

Many press relations minded companies however, know as much about the editorial make-up and functions of the publications they want to hit as the editors themselves. They study and analyze several issues of the various publications and even go to the extent of diagramming the editorial breakdown of the publications. The breakdown can then be keyed in a way to guide the composition and routing of press releases. This practice obviates the wasted time, money and effort that results from sending a press release about a new shampoo to a civil engineering magazine.

Knowing the publication also means knowing its closing dates and timing releases accordingly. The hottest story in the world screams in a wilderness the day after closing and the scream will die away to a whinny by the time the next issue goes to press. As more industrial magazines increase their frequency of publication, and as more companies go after publicity in the industrial pages of daily newspapers, the timing of release dates becomes a critical determinant of good press coverage.

(*Continued*)

Above all fairness in dealing with publications is the hallmark of the compentent press relations man. Scoops and "exclusives" in the news field have become as rare as Wall Street plungers. Modern stepped-up communication and interchange of information have brought this about. Today, the big premium is placed upon interpretation of the news. This in turn puts emphasis on the need for local color and factual background information in the modern news release or appended to it.

KNOW THE EDITORS

The opinion of disappointed press relations men to the contrary notwithstanding . . . . editors are human beings. They are paid to do a job and have a normal amount of human conscientiousness to do it well. Like others in the role of observer, however, they tend to get a little case-hardened and a slight bit cynical about the constant stream of enthusiasm to which they are exposed. Most industrial editors have had some working experience in the industry that bakes their daily bread and therefore tend to be less impressionable about developments than their counterparts on daily newspapers.

For this reason the industrial editor is more interested in the "how" and "why" a thing works than in the plain fact that it does work. A new process to manufacture an antibiotic, for instance, would have good lay reader appeal in almost any newspaper in the country. But an industrial chemical magazine two or three weeks later would have to give at least a sketchy account of how the process works or how the new product will fit into the field to justify its role of serving technical readers. Each publication will try to slant this material towards its individual needs . . . and that's where a "first name," phone-call type relationship between the PR man and the editor pays dividends.

This working friendship is best cultivated by each party developing a sympathy for the other's work-a-day world. The PR men who realize this set aside regular visit-the-editor weeks on their calendars. They see the galley slave in his natural habitat and get a first hand opportunity to get the feel of the publication's function, plans and limitations. On these visits other editors on the various staffs can be met and their individual wants and squawks heard . . . . . and the chances are that the editor-host may even pick up the luncheon check. Hath any man greater love?

But friendship implies two-way

(*Continued*)

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visits. The press relations man who is never too busy to spend some time gabbing with editors who drop in will never regret it. The guest may have no definite story idea in mind on such occasions but is on one of his visit-the-news-source junkets. At this time stories that may not break for some months hence can be discussed and planned. The editor may have many good suggestions to offer the PR men regarding release dates, circulation of releases and the composition of the release itself. Wise PR men listen.

WHY A PRESS RELEASE?

If the three "knows" have been mastered a favorable environment for the preparation and reception of press releases is created. But before the typewriter is pounded, a few minutes of reflection upon the basic philosophy of the release can help a lot.

An industrial news release has the prime function of transmitting pertinent information to the editors of publications that might be interested in developing a news story or brief around the subject. But there is a second and often as important function of releases that is often overlooked by the people who write them . . . . . that of keeping the editor well posted on company developments. This holds whether or not the editor chooses to give them immediate editorial attention in his pages. An adequate, factual running account of the history of company, a process or a product in the making makes life easier for the editor and therefore tempts him to write the real payoff piece in sound industrial publicity work . . . the feature story.

A studied approach to the problem of industrial publicity may sound like a tall and expensive order, especially to the small manufacturer who cannot afford the services of a publicity department staffed by professional publicists. But actually it isn't. For it is a distinct credit to the American industrial press that a three cent letter from Mr. Little about his new development will get just as much attention as a heftier and more elaborate press release from Mr. Big's publicity department or agency, provided it presents facts and contains news appeal.

After all, an editor is essentially a creative gent who likes to be proud of his work. His claim to fame, if any, is the ability to pick the real reader interest items out of a mountain of mediocrity. The press release that does its job need never fear an early demise in an editorial waste-paper basket.

—End

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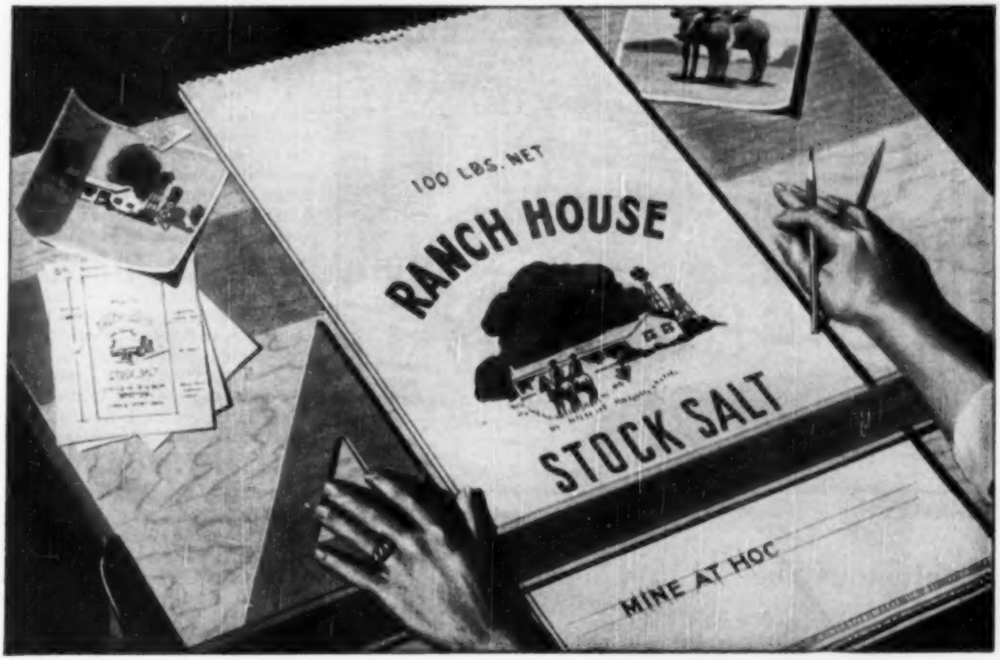


UNION package designers can transform the fine printing surface of a Multiwall Bag into a compelling advertisement for your product at the point of sale—where advertising really pays off! Your brand name and trademark, exclusive features, formulations and instructions for use—all can be presented with color and drama to help make your product sell.

That Union package designing *really sells* has been proved year after year in the sales records of many companies—and repeatedly proved in national packaging competition.

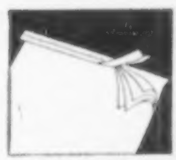
This packaging experience is yours to command, through your Union Multiwall representative. Use it!

* * *

SPECIAL NOTE TO USERS OF OTHER TYPES OF PACKAGING

Companies making over 300 different products have cut packaging and handling costs by switching to Union Multiwall Bags.

When your Union Multiwall representative calls let him analyze your entire packaging problem to see what savings you can effect!



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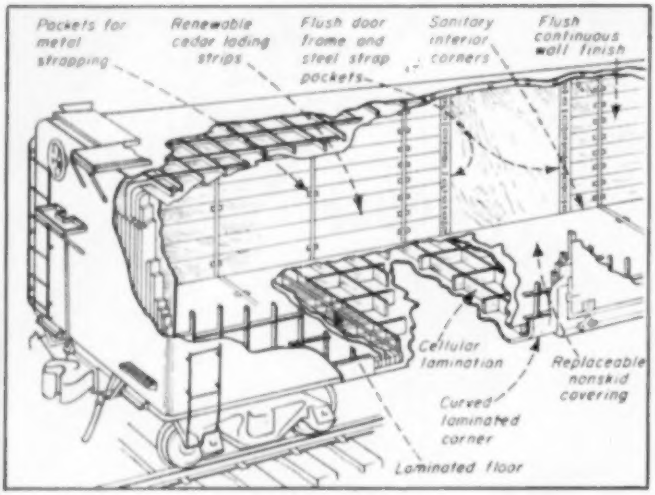
Handling, Packaging and Shipping

R. W. LAHEY, Editorial Consultant



Car is closed tube of continuous laminated plywood with cross members reinforcing.

Continuous Shell of Plywood; Innovation in Freight Cars

The first really new boxcar in 52 years offers greater capacity, lower cost, cuts use of steel to less than half

Today some 1.7-million freight cars may be found on rails and sidings throughout the country. Of these, the car built many years ago is still pretty much the same as the one put in service only last week. To paraphrase John Snyder, president of the Pressed Steel Car Co., it's time to get the lead out of the pants and the steel out of the cars.

So his company came up with a brand new idea, or rather a new application of some pretty well-known ideas. They take light-weight, special strength woods, phenolic and resorcinol resins, special insulators, put the materials together to form one continuous shell (see p. 225) and out rolls Unicel, a wooden freight car stronger than any comparable steel one.

Before Korea the ICC pegged our needs at 900,000 new freight cars in the next five years; 15,000 cars a month. Is this new car the answer to this and the $135-million-a-year-headache in damaged lading? Many a shipper hopes it is.

Here's a list of advantages:

1. It costs less and weighs less. The maker says that eventually for every 1,000 cars a railroad might buy, it will be able to purchase 1,200 Unicels. Total steel weight of the car is 18,000 lb.—practically all in the undertruck. Each car represents a saving of 11 tons of steel at a time when the material threatens to become critical.

2. It's bigger. Roughly one-fifth longer than present cars. There's more volume too—915 cu. ft. of it—when used as a freight car. Besides taking advantage of the extra length, you can load to the roof with Unicel. The corners are rounded and the walls are thinner. When used as a refrigerator car (the dual-personality car changes easily from one to the other) the space gain over conventional cars is even greater.

3. It's much easier to load. The doors are 2 ft. wider than on ordinary cars. Fork lift trucks easily fit into the car and ride on the special floor permitting simple loading of bigger pieces. In tests, the company ran a 6,000-lb. power lift truck with a total load of 8 tons, freely over the floor of the car. No damage was done.

4. In spite of—or rather because of its wooden construction — Unicel is stronger pound for pound than a steel car. Tests at Armour Research Institute proved the wooden shell has greater impact strength. Explanation is simple: concentrated forces up to 50,000 psi. have to be reckoned with in conventional cars. Not so in Unicel. The greatest stress on any one part is 3,000 psi.

5. Easier fabrication, fewer man-hours to assemble, may be packed for knock-down assembly overseas. Fewer highly-skilled workers are needed to assemble Unicel. Welders, riveters, steelworkers are unnecessary with wooden construction.

6. Efficient insulation. Conventional refrigerator cars vary from 10 to 12 deg. in holding cold (or heat). Unicel varied only 2 to 3 deg. in tests with heats as high as 165 deg. F. in over a month's experimentation.

7. The car is easily cleaned because the inside is one piece, walls are smoother, corners rounded, joints are tightly sealed and the finish is impervious to contamination.

Additional advantages are less vibration, easier sectionalizing (it's done with a gridded steel gate that's flush with all surfaces: ceiling, floor, walls. A special steel seal closes the dunnage effectively preventing pilferage.) There's also a gimmick called Unistrapping. With it, the shipper ties his load to the walls and on the floor of the car. Lading stays put however rough the ride.

The new car has stood up under some pretty rugged tests. For instance, railroad men consider collision speeds to be in the range of 4 to 10 mph. The new car has been impacted at speeds more than 15 mph. without damage to either car or contents. In

(Continued)

If you need a control mechanism which can **combine** control signals

Send for this bulletin

In all except the very simplest control systems, there is need for control mechanisms which can combine control signals. Some of these combinations involve addition or subtraction of control signals, while others involve multiplication, division, or even more complicated functions. The Hagan Ratio Totalizer was designed for almost universal application in this type of service. It represents an advance in simplicity and versatility over all devices of this class which have been available previously.

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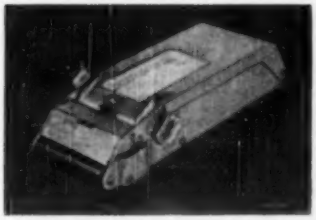
CE-12

fact the car is constructed to withstand impacts of 23 mph. by means of a special draft gear of laminated rubber cushions called Unisorb. In addition it has also successfully completed static load tests for longitudinal and transverse deflection.

Bulb Type and Carboy Tilter Pumps Dispense Acids

The Thompson bulb type acid pump is recommended by the Heinz Manufacturing Co. as a safe and efficient method of dispensing acid from their 15 gal. stainless steel container. The bulb, when pressed by hand, forces air into the container which in turn forces the liquid out through the pipe which extends to the bottom of the drum. A flow of approximately 2 gpm. may be obtained in this manner.

For faster pouring the Thompson carboy tilter is recommended in conjunction with the air vent pouring spout made by the same manufacturer. The container is clamped in the tilter by positive means and tilting is controlled by a ratchet. The pouring spout prevents surges and splashing of the acid by means of the air vent. Flow capacity is 5 gpm.



Hand Applicator Does Whole Package-Labeling Job

A system of labeling adopted by Johnson & Johnson for their new warehouse near New Brunswick, N. J., offers certain advantages where labels are used in large quantities. This system, known as Label-Flow of the Standard Register Co., consists of a hand applicator which issues, moistens, rolls the label on the package and cuts it off in one sweep of the hand. Pressure on a lower lip of the device actuates a pin feed ejector. As the label is rolled on, the machine detaches it from the strip.

Holding 350 labels, size 3¼ by 6½ in., labels can be preprinted, or they can be prepared on an addressing machine equipped with the pin feed device or they can be written by hand in the machine and immediately applied.

More ICC Regulation Changes for Your Files

On August 29 the ICC published amendments to their regulations. These changes became mandatory on November 27. Those amendments of special interest are summarized below. The order should be consulted for complete details.

SEC. 31(g) NOTE 2. TANK CAR SHIPMENTS OF PETROLEUM ALKYLATE ISOPENTANE AND OTHER FLAMMABLE LIQUIDS WITH VAPOR PRESSURES NOT OVER 40 psia. At 100 deg. F. The emergency authorization for shipments of these compounds in Spec. ARA IV, and I.C.C. 104 tank cars converted has been cancelled.

SEC. 61-5(g)(1)(i) BLASTING CAPS & ELECTRIC BLASTING CAPS. These caps may now be packed 100 to a pasteboard carton instead of 50 previously authorized.

SEC. 65(a)(3) NOTE—AEROPLANE FLARES. The emergency authorization covering packing of these flares in Spec. 12B fiber boxes has been cancelled.

SEC. 76(b)(2) RAILROAD FUSEES, FLARES. These fusees when packed in Spec. 12B fiber boxes must be reinforced to prevent the spikes from puncturing the containers when dropped twice from a height of 4 ft. Thus, sheet metal or wood reinforcements are no longer required.

SEC. 190(b)(7) PHOSPHORUS, WHITE OR YELLOW. These materials may be shipped in Spec. 103W tank cars in addition to that previously authorized. All other requirements apply except insulation over external heater coils may be reduced to a thickness of 2 in.

SEC. 217 SODIUM, METALLIC, DISPER-

(Continued)

PACKAGING, *cont.* . .

SION IN ORGANIC SOLVENT. This material has been added to the regulations and may be shipped when packed as follows: Packed in 15A wooden boxes in inside metal cans not over 1 qt. capacity packed in another metal can and cushioned on all sides with at least 1 in. of soda ash. Both the inner and outer metal cans must be equipped with an air-tight closing device secured by positive means (not friction). Gross weight of shipping package shall not exceed 100 lb.

SEC. 262 SODIUM CHLORITE SOLUTION. This compound has been included in the regulations and may be shipped in the same containers which are approved for hydrochloric acid.

SEC. 263(a)(10) HYDROCHLORIC ACID. Spec. MC 310 motor vehicle tanks may now be lined with acid resistant material that is equally resistant and of equivalent strength and durability to rubber which has been the standard lining.

SEC. 272 SULPHURIC ACID (OLEUM, OIL OF VITRIOL). This section has been altered for clarification purposes.

SEC. 273(d) SULPHUR TRIOXIDE STABILIZED. Spec. 17F single trip metal drums with venting plugs have been added to the list of approved containers.

SEC. 280 FLAME RETARDANT COMPOUND, LIQUID has been included in the regulations as a corrosive liquid and must be shipped as follows:

Spec. 1A, 1B, or 1C.—Carboys in boxes or kegs which must be closed, and when reused must be reconditioned and tested, as provided in the specification.

Spec. 1D.—Boxed glass carboys of not over 6.5 gal. nominal capacity which must be closed, and when reused must be reconditioned and tested, as provided in the specification; means shall be provided so that accumulated pressure in bottle shall not exceed 10 psig. at 130 deg. F., or shall vent at a pressure not to exceed 10 psig.

Spec. 1X.—Boxed carboys of 5 to 6 gal. capacity, single-trip for export only. For shipment via common carriers by water to noncontiguous territories or possessions of the United States and foreign countries; shipments from inland points in the United States which are consigned to such destinations are authorized to be transported to ship side by rail freight in carload lots only and by motor vehicle in truckload lots only.

Spec. 10A.—Wooden barrels or kegs, lined with asphalt or rubber.

Spec. 11A, or 11B.—Wooden barrels or kegs with inside containers which must be glass or earthenware, not over 2 gal. each.

Spec. 15A, 15B, 15C, 16A, or 19A.—Wooden boxes with inside containers which must be glass or earthenware, not over 1 gal. each, except that inside containers up to 3 gal. are authorized when only one is packed in each outside container.

Spec. 28.—Metal-jacketed lead carboys.

Spec. 103B, 103B-W, 108, or 108A.—Tank cars.

SEC. 302(h) PACKING COMPRESSED GASES. Soaps and cosmetics may be packed in metal cans under pressure provided they are packed to comply with the regulations governing foodstuffs packed under pressure.

SEC. 203K & 302(q)(1) DICHLORODIFLUOREMETHANE AND DIFLUOROETHANE MIXTURE (constant boiling mixture) is a compressed gas and may be shipped in ICC 3A240, 3B240, 4A240, 4B240, 4BA240, or 9 cylinders, maximum permitted filling density 100 percent. The gas may also be shipped in ICC 106A500 tank cars, maximum filling density 100 percent and in ICC 105A300 tank cars, maximum filling density 105 percent.

SPEC. 3A(23) CYLINDERS of special type are not now authorized for trial service until authority in writing for construction and use is received from the Bureau of Explosives.

SPEC. 3AA(10)(b) CYLINDERS. Steel temperature on quenching has been increased from 1,650 deg. F. to 1,750 deg. F.

SPEC. 21B. FIBER DRUMS. This new specification eliminates most of the detailed construction requirements and substitutes test requirements. The performance specification includes chime drop, flat drop, and end compression tests to be supervised by the Bureau of Explosives.

—*End*

PICCOLASTIC RESINS

Provide these desirable characteristics

Pale color
Melting points 5°C to 150°C
Unsaponifiable
Stable in package, body and film
Permanently thermoplastic
Acid and Alkali resistant
Five grades—soft to hard, horny
Soluble in aromatic hydrocarbon and other low-cost solvents

The many desirable qualities of Piccolastic Resins are used to good advantage in a wide variety of products. They are made from Styrene type materials, and are available in five grades, from viscous liquids to hard, horny solids. Intermixes of the various grades permit an unlimited range of properties.

Their pale color permits their use for many applications. The entire line is soluble in aromatic hydrocarbons and other low-cost solvents. They are acid and alkali resistant to a high degree, and are unsaponifiable.

WRITE FOR SAMPLES. **If you will tell the intended application, we will be glad to suggest the proper grades and send samples for you to test.**

PICCO

PENNSYLVANIA INDUSTRIAL CHEMICAL CORP.

Clairton, Pennsylvania

Plants at Clairton, Pa.; West Elizabeth, Pa.; and Chester, Pa.

Distributed by Pennsylvania Falk Chemical Co., Pittsburgh 30, Pa. and Harwick Standard Chemical Co., Akron 5, Ohio


for chemical process and industrial gas
NEW Wiggins Gasholder
has gas-tight, impermeable DRY SEAL
General American Offers the First Basic Gasholder Improvement in 25 Years
NO WATER! TAR! GREASE!
NO OPERATING COST!
LOW FOUNDATION COST!
NO SERVICING COST!
WEATHER HAZARDS LICKED!
Keeping pace with the leaps-and-bounds growth of the chemical process and industrial gas industries, the Wiggins Gasholder brings new simplicity, new economies, new safety to gas storage. The Wiggins dry seal principle is proved by 15 years' service in the field.
New simplicity! There's no water to freeze, contaminate the gas, or accelerate corrosion. No winter worries because of tar or grease. At last—a weatherproof gasholder!
New economies! Savings start right with the foundation which can be built lighter because there's no water load to support. Eliminated, too, are the critical tolerances and delicate assemblies of conventional gasholders. There's no need for constant inspections and maintenance. What's more, long range remote operation is now possible.
New safety! Explosive or toxic mixtures cannot accumulate above the piston and are controlled by complete ventilation.
Wiggins Gasholders operate at any pressure up to 20" of water. They can be built in capacities from 1,000 cubic feet to 10,000,000 cubic feet.
EVERY PROCESS ENGINEER SHOULD HAVE FULL INFORMATION ON THE WIGGINS GASHOLDER
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News From Abroad

SPECIAL CORRESPONDENCE

West Germany Ups Plastics Production and Exports

Munich—Spurred by the outbreak of Korean hostilities and improving export business, West German plastics production has advanced substantially above last year's levels. Output in 1949 had reached 70,000 tons as compared with 20,000 tons in 1936 and 250,000 tons at the end of the war.

Parts of the industry are rapidly approaching the limit of their capacity. In others, supply of raw materials is giving rise to serious concern. Germany has to import benzene and phenol which are in short supply because of high prices and strong United States demand. And only a fraction of her polyethylene requirements can be produced at home. It was the acute shortage of all raw materials which kept production at very low levels in the immediate postwar period.

Direct exports, while still substantially below the prewar level (26,600,000 RM in 1936), have risen from 1,900,000 DM in 1949 to an estimated annual rate of 8,000,000 to 9,000,000 DM this year. Exports have been aided by the liberalization of intra-European trade, with western Europe currently the main foreign market.

Plastics Raw Materials Short in Britain

London—A couple of chain reactions have caused shortages all along the British plastics industry's supply line.

The Korean war and inauguration of the United States defense program brought on limitations in styrene polymer and monomer supplies. They rapidly became insufficient to meet the United States needs for plastics and the increased demands for synthetic rubber. Then early in October supplies of the vinyl copolymers were restricted.

Failure of the Brazilian cotton crop set off curtailment in the cellulosics market. That coupled with the recent price rise in acetic anhydride hiked up prices of cellulose acetate flake. In an attempt at conservation, suppliers cut down deliveries or suspended them indefinitely.

Which brings us back around to the polystyrene shortage which forced injection molders to turn to cellulose acetate and swamp a market already flooded with orders.

Chilean Oil and Gas Plant Under Construction

Punta Arenas—On the island of Tierra del Fuego, 80 miles south of Punta Arenas, the Chilean government plans to put up a $3 million oil and gas processing plant. It is scheduled to begin handling 30 million cu. ft. of gas and 6,000 bbl. of oil daily by June 1951. Butane and heavier hydrocarbons will be extracted from the gas, and the stripped gas will be returned to the reservoir.

Source of gas and oil will be the Spring Hill Field, the first field developed in Chile. Discovered in December 1945, it currently has about 40 producing wells.

Corporacion de Fomento de la Produccion, a Chilean government division, has hired the Hudson Engineering Corp., Houston, Tex., to develop the process and mechanical design of the plant, assist in purchase of equipment and supervise construction.

Australians Put New Wrinkle In Black Liquor Recovery

Melbourne—Lance-hole blocks of monolithic soapstone construction have been built into the walls of the black liquor recovery furnaces of the Australian Paper Manufacturers Ltd. at its Maryvale kraft mill.

During the recovery process, solids pile up on the boiler tubes mounted above the furnace. Frequent air lancing of the furnaces, as well as soot blowing by steam, keep the boiler tubes clean. In the new blocks the lances are inserted through one or two oval tapered holes which allow them to swing over a wide arc in a plane parallel to the row of tubes. Soapstone has exhibited excellent erosion resistance. Replacement, when necessary, is simple because of monolithic construction.

Australian Paper Manufacturers' new development offsets several disadvantages of the conventional cylindrical hole which opens at a junction of two or more firebricks in the furnace wall. The lance can swing over only a small arc so many holes are needed to cover the tubes completely. The holes wear rapidly because of firebrick's poor erosion resistance.

Brazil to Produce Titanium Oxide

Sao Paulo—Brazil will refine its own titanium oxide for use in the paint and similar industries by early next year. A plant is being built here by Companhia Quimica Industrial, CIL, S.A. which will supply all of the country's domestic demand.

Output will be about 10 tons daily. Byproducts include synthetic iron oxide and about 50 tons of sulphuric acid daily. Also, barium sulphate ore will probably be processed.

The plant is the first of its kind in either Central or South America.

ICI to Produce New Synthetic Fiber

London—A plant to turn out a new fiber-forming polyester is under construction at Wilton, North Yorkshire. Cost is quoted at several million pounds sterling. Full-scale production which is expected in four or five years will be 11 million lb. a year.

Raw materials will come from the oil cracking plant which Imperial Chemical Industries has now almost completed on the same site. Made by the condensation of ethylene glycol

(Continued)

McGRAW-HILL *World News*

with terephthalic acid, the polyester is produced in fiber form by the melt-spinning process invented by Du Pont for nylon.

The fiber is known as Terylene in England; in America, Du Pont calls it Fiber V. Twice as strong as cotton, it stretches very little, has good resistance to weathering and acids. It produces a quick-drying, silk-like fabric. Imperial Chemical Industries has full manufacturing rights for the whole world outside of the United States.

Monsanto Makes Polystyrene In Australia

Melbourne—Australia will be manufacturing its own polystyrene soon at an $820,000 plant to be built in Melbourne by Monsanto Chemicals(Australia) Ltd.

Plant design is based on information supplied by the American Monsanto Co. and the process will involve conversion of styrene monomer (supplied by the same company's Texas City plant) to polystyrene suitable for molding. Ultimately the plant's output will be large enough to satisfy all Australia's requirements.

Netherlands Phenol Plant Nears Completion

Amsterdam—Netherlands State Coal Mines' new plant at Lutterade will soon begin producing phenol from benzene by a new process invented in the mines' laboratories.

The entire output is destined to go into the production of Enkalon and Akulon, products based on Du Pont nylon patents purchased by the Aku concern.

Canada to Pipe Alberta Gas

Ottawa—A $220 million all-Canadian pipeline project has been planned to carry Alberta gas direct to approximately 3,500,000 Canadians in Saskatchewan Manitoba, Ontario and Quebec.

A new patented dehydration invention will allow the gas to be pumped in subzero weather without burying the pipe. The main pipe, 30 in. in diameter, will be laid mostly along open ground. Underground storage in depleted gas and oil reservoirs in Ontario will be used providing a reservoir of two months capacity.

The plan is being developed by Canadian Delhi Oil Ltd., subsidiary

(Continued)

EXTRA **CI NEWS** EXTRA

NEW YORK, N. Y., NOVEMBER 1, 1950

CHEMICAL INDUSTRIES TO GO WEEKLY...

Frequency Increase Planned Jan. 19th

TO PROVIDE FASTER NEWS COVERAGE FOR MANAGEMENT MEN

New York, Nov. 1 — McGraw-Hill Publishing Co. announced today that its recently acquired CHEMICAL INDUSTRIES will become a weekly newsmagazine in January, 1951. This increased frequency of the 36-year-old publication (a monthly since 1933) gives its audience of chemical business men faster coverage and analysis of process industry news.

Circulation Shows Gain

CHEMICAL INDUSTRIES, concentrating the major power of its circulation on top level executives in the field, has already shown substantial gains since its purchase by McGraw-Hill in August. Circulation effort is being directed to the business-minded men who direct the affairs of the chemical producing and consuming industries. They include executives in management, finance and administration; heads of research, development, sales, marketing, purchasing and packaging. From the present circulation of 10,700, a minimum of 18,000 is assured by the end of 1951.

Differs from Chemical Engineering

Its McGraw-Hill contemporary, CHEMICAL ENGINEERING, which has been outstandingly successful in serving the production-engineering and production-management groups, will continue to be published monthly and edited as the workbook of the Chemical Process Industries. Conversely, CHEMICAL INDUSTRIES is written primarily for management men concerned with interpreting the significant industry events and developments rather than the detailed engineering problems of processing methods and operations.

Offers Increased Service to Advertisers

With the conversion of CI to a weekly, McGraw-Hill now offers the many advertisers selling to the Chemical Process Industries more complete coverage of all important buying functions in the field. The future of both publications holds great possibilities for continued growth, and increasing obligations and opportunities for service.

CHEMICAL INDUSTRIES invites campaigns of advertisers whose success depends on gaining acceptance for their products and services among the influential management leaders in the upsurging chemical process industries — largest and fastest growing of America's industrial markets.

FOREIGN NEWS, *cont...*

of Delhi Oil Ltd., subsidiary of Delhi Oil Corp., Dallas, Tex.

Glass and India—New Delhi—A fully-equipped modern glass factory located in Calcutta is offered for sale or lease. This factory was built and operated under the supervision of an expert Czech glass manufacturer but due to certain internal difficulties the company has ceased operations. Now the Indian Government is anxious to interest foreign capital in re-establishing this plant.

Canadian-British West Indian trade—Ottawa—A new import plan makes it possible for Canadian exporters of chemicals and allied products to obtain import licenses in the British West Indies for 33⅓ percent of their average exports by value to the individual colonies during the base period of 1946 to 1948. The colonies concerned are Jamaica, Trinidad, Barbados, British Guiana, British Honduras, Leeward Islands, Windward Islands and the Bahamas.

Adhesives for west Canada — New Westminster—Dextrin, pastes, flexibles, resin- and rubber-based emulsions are among the adhesives turned out at Swift Canadian Co.'s plant just opened in New Westminster. The company's fourth such unit in Canada, it is slated to supply the expanding market west of the Rockies.

French export licenses — Paris — The French Finance Ministry has published a list of goods which may be exported in future without an export license. This list includes oxide and hydroxide of cadmium and cobalt, barium and cadmium sulphides, magnesium and cobalt carbonates, zinc and lead chromates, bichromates and artificial fibers.

Asbestos for Natal—Johannesburg—A new asbestos mill has just gone into production. Initial production is estimated at 50 tons a month. Output soon will be stepped up to the factory's capacity of 300 tons a month of chrysolite asbestos fibers.

German penicillin — Frankfurt — Large scale production of penicillin has been started in the recently-finished plant of the Farbwerke Hoechst near Frankfurt. At present, the monthly output is 400,000 million units, sufficient to supply the en-

(Continued)

tire demand of western Germany. Production could be expanded to supply other countries if necessary.

More drugs, less chemicals enter Australia—Melbourne—In the year ended June 30 Australia imported $398 million worth of drugs and chemicals. Imports of soda ash dropped from $1,646,000 in 1948-49 to $387,000 in 1949-50, and of caustic soda from $1,850,000 to $331,000. Imports of drugs and medicines accounted for $7,130,000 of the 1949-50 total, contrasting with $14,960,000 in 1948-49. The increase was more than sufficient to offset the currency slump.

Brazilian sheet glass—Rio de Janeiro—Production today exceeds 4 million sq. m. a year and is sufficient for normal national requirements, according to testimony offered before the commission on Foreign Trade Agreements. Industry representatives made the statements in support of a plea to have that section of a British trade agreement reduced from the proposed value of 80,000 to 100,000 sterling to no more than half of that value.

Uranium controls—Brussels—The Belgian government is said to be planning an atomic energy commission to control production, sales and use of Congo-mined uranium.

It's cold—Ottawa—The National Research Council of Canada has announced that research equipment has been installed in its laboratories for producing temperatures within a few degrees of absolute zero. This recently-developed equipment is called the Collins Helium Cryostat and was made in the research and engineering laboratories of Arthur D. Little, Inc., in Cambridge, Mass. The low temperature is produced by the liquefaction of helium.

Australia and Fertilizers—Brisbane—Two overseas corporations are investigating economic methods of producing nitrogenous fertilizer from Mount Morgan pyrites, according to the Queensland Minister of Labor and Industry, Mr. Jones. He said a factory would probably be established at Gladstone, Rockhampton or Mount Morgan at a cost of about £3 million, and about 100 men would be employed in the new industry. Production of this fertilizer might eventually become one of Queensland's major industries, he added. —*End*

LET THE RECORD SPEAK!

MANY corrosion-resistant materials are suitable for specific operations, BUT can they handle UNFORESEEN changes in operating conditions? The six materials shown above were subjected to conditions outside their range of application. They failed. But "Karbate" impervious graphite took all these conditions, and will continue to take them, not for days or weeks, but for years.

Your best bet to avoid scrapping equipment due to a process change is to specify "Karbate" impervious graphite.

MORE THAN DOUBLE THE USABLE LIGHT!

The biggest news since the invention of flashlights—the brand new, leak-proof "Eveready" No. 1050 flashlight battery—gives you more than double the usable brilliant white light for critical uses than any other flashlight battery we have ever made. NO METAL CAN TO LEAK OR CORRODE.

The terms "Karbate" and "Eveready" are registered trade-marks of

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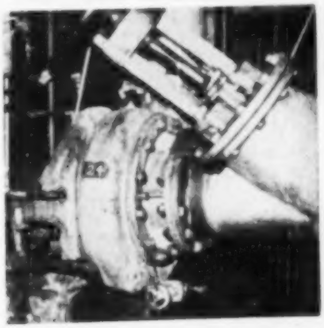
Foreign Department: New York, U. S. A.

The Corrosion Forum

MORGAN M. HOOVER, Assistant Editor

Construction Materials in the Paper Industry Part III—Acid Pulping

Part III of a symposium in which materials of construction are evaluated for various services in the paper industry. Parts I and II dealt with stock handling and bleaching, respectively. Part IV will deal with alkaline pulping.



Worthite pump used to transfer sulphite liquor from accumulator to digesters.

Worthite

W. E. Pratt, *Worthington Pump and Machinery Corp., Harrison, N. J.*

In the acid pulping processes the digester liquor is usually calcium bisulphite. Sulphur is burned to sulphur dioxide, the gas is cooled and absorbed in water to make sulphurous acid, which in turn contacts limestone to form the raw calcium bisulphite cooking liquor. This reaction is commonly carried out in Jenssen towers packed with limestone, the SO_2 gas passing upwards countercurrent to the water or acid flowing downwards. Water is introduced into the top of the first tower and a pump delivers the weak acid to the top of the second tower. Another tower pump takes the strong acid from the bottom of the second tower and delivers it to the settling tank, storage or to the reclaim tank. The reclaim or accumulator tank is so called because the digester relief gas is piped into this tank for absorption into the liquor.

Usual practice for an acid tower installation is to provide three towers with only two in use while the third tower is being repacked with limestone. Occasionally four towers are used. The older milk of lime systems employ a series of tanks as a cascade or a tower partitioned off into sections. Cooking acid made in this system requires settling before passing to storage or to the accumulator. It will be seen that in either system two to four acid pumps may be required. Worthite pumps are very frequently used for these services. They seem to be practically corrosion-proof as Worthite pumps in these services for 13 years show no attack. This is a great improvement over the bronze pumps formerly used before the advent of the chrome-nickel and nickel-chrome-moly alloys.

Prior to passing the sulphur dioxide gas over the acid towers, the gas must be cooled to as low a temperature as practical as the absorption is greater at the lower temperatures. Gas cooling is frequently accomplished by drawing it through cooling towers over which water is pumped. As the water picks up a little of the SO_2 at this point acid pumps are required. This is another place where Worthite pumps are used frequently. The cooling water enters the tower through a distributor pipe which it has been found economical to make of centrifugal cast Worthite pipe with suitable drilled holes.

In the digester room additional pumps are required for filling the digester with cooking acid, boosting the acid into the digester after it is under partial or full pressure, and in many mills the cooking acid is recirculated around the digester through indirect heaters. Standard Worthite pumps are available for all of these services, except for some recirculating systems where special pumps are required built to order. In such cases the 18/8S, molybdenum or Type 316 stainless steels may be used due to the lower cost. Where standard Worthite pumps will meet the hydraulic requirements the Worthite pumps will be lower in cost due to volume production.

Worthite may have some additional advantage over the moly-bearing stainless steel where some sulphuric acid is present. Sulphuric acid may be formed on wetted surfaces during shut down periods. Also some SO_3 is likely to be present at times during periods when the system is a little out of balance, or in the milk of lime systems. This SO_2 must be scrubbed out as completely as possible and it is done usually in lead towers over which a hot, weak mixture of H_2SO_4-H_2SO_3 is circulated. This solution is reducing in nature and tends to activate the nickel-chrome-moly alloys. Concurrently, the lead in the towers and pipes takes on a heavy coating of lead sulphate which may be cathodic to an alloy pump or valve, causing galvanic action damaging to the alloy. Worthite is very resistant to the corrosive action of the solution but a Worthite pump should be completely insulated from any metallic contact with the lead in such systems. The Worthite pumps handling the H_2SO_3 alone, or the cooking acid, remain in the passive state and hence are cathodic (passive) to lead and are therefore galvanically protected by contact with the lead.

The relatively new acid pulping liquor, employing magnesium or ammonia base sulphite liquor, presents similar corrosive problems. Since these liquors may be recovered in a similar manner to the sulphate (alkaline) liquor employed in kraft pulp mills, by concentrating the weak wash liquor and burning in a recovery boiler, many more chemical pumps are required in the recovery processes. Worthite pumps are used in the few plants employing these newer digester liquors and they are giving an excellent performance.

Some of the sulphite mills have taken steps to avoid stream pollution and have installed various processes to utilize the chemical values in the waste liquors. Worthite is suitable for all of the corrosion problems involved in such plants. One of the sulphite-pulp mill byproduct plants manufacturers vanillin and Worthite pumps are used in this plant.

The following corrosion tests on

(Continued)

Worthite in Sulphite liquors were reported by the International Nickel Co.:

"Spool installed for 54.5 days in 4 in. pipe just below the upper cone of No. 4 tank for digestion of wood chips with sulphite paper digester liquor (average initial composition 8.23 percent total SO_2, 7.02 free SO_2, 1.21 combined SO_2, cooking acid 7.42 total SO_2, pH 1.32). No aeration, slight agitation, temperature 267 deg. F. (65-70 psig.). Worthite corrosion rate 0.00008 in. per yr., no pitting.

Spool installed 28 days in cover of a sulphite digester (cooking liquor: total SO_2 7.87 percent, free 6.82, combined 1.05) for manufacture of newsprint. No aeration, some agitation, temperature 291 deg. F. Worthite corrosion rate 0.00013 in. per yr., no pitting.

Spool was installed for 51 days attached to the digester strainer, used in sulphite pulp cooking. Liquor contained 7.5 percent total SO_2; 1.2 was combined, 6.3 free. Temperature 86-293 deg. F. No aeration or agitation given. Worthite corrosion rate 0.0001 in. per yr., no pitting."

SO_2 gas cooling system made of antimonial lead.

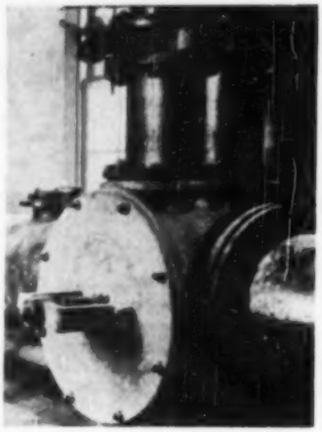
Lead

Kempton H. Roll, *Lead Industries Association, New York, N. Y.*

Acid pulping is the process of digesting cellulosic materials such as barked and cleaned wood by cooking it in sulphite liquor. The product of acid pulping is essentially pure cellulose pulp, the unwanted and unstable lignin and other non-cellulosic components of the wood having been dissolved away by the treatment.

"Acid" in acid pulping refers to the sulphite cooking liquor which consists of the acid sulphites or bisulphites of calcium and occasionally magnesium in solution with sulphur dioxide.

The manufacture of the sulphite cooking liquor, an operation invariably conducted on the premises of each individual pulp mill, begins with the burning of sulphur in conventional burners to form sulphur dioxide. While it is theoretically possible to secure a gas of nearly 20 percent concentration, practice has shown this to be impossible because the excess air input together with small amounts of moisture in both the sulphur and the air combine to favor the formation of sulphuric acid. Temperature also plays a part in the conversion of sulphur dioxide to trioxide; hence the necessity for cooling the gas as rapidly as possible through the critical temperature range. As long as the gas temperature is above the boiling point of sulphuric acid (about 600 deg. F.) iron piping is satisfactory. But when the temperature is sufficiently reduced sulphuric acid mist forms and corrosion proceeds at a rate making most construction materials impractical with the exception of lead and its alloys, antimonial lead and tellurium lead.



Plug cock and cast lead damper between absorption towers.

Normally the temperature of the combustion chamber is 2,000 deg. F. or above. The sulphur dioxide gas enters the distributing header over the cooler at about 1,400 deg. F., depending upon the length of piping between the combustion chamber and cooler and the ambient temperature. In order to permit proper absorption of the gas in the acid making towers it must first be cooled to 90 to 150 deg. F.

It is in this cooling step that lead because of its resistance to sulphuric acid plays such an important part. The gas is distributed to a number of lead pipes usually 8 in. in diameter with ½ in. wall and about 15 ft. long, submerged in a pond of cooling water. These, in turn, discharge into a submerged lead header to which are connected a multiplicity of vertical elliptical lead pipes, 3 by 8 in., ¼ in. wall and about 15 ft. high. A typical gas cooling system constructed entirely of antimonial lead is illustrated. The elliptical lead pipes are individually connected at the top by a short section of lead pipe to a second set of vertical elliptical piping leading to a second submerged header, thence to a third set of similar piping and finally to a fourth set which is connected to a header leading to a gas fan.

All the cooling water before entering the pond is distributed at the top of the vertical piping so that a film covers the entire surface. Thus the gas gets a preliminary cooling in the submerged lead pipes and final cooling in the four passes into vertical elliptical pipe. The sulphuric acid condensed in the cooler is trapped out from each of the submerged headers but is not completely removed from the gas. Of recent years tellurium lead as well as antimonial lead has been used for cooler piping.

From the coolers the gas enters a large fan which pulls the gas through the sulphur burner combustion chamber and gas cooler and then forces it up through the acid or absorption towers. The fan bowl is cast antimonial lead split horizontally to permit cleaning; the impeller either cast

(Continued)

Cast lead SO_2 gas fan between cooler and absorption towers.

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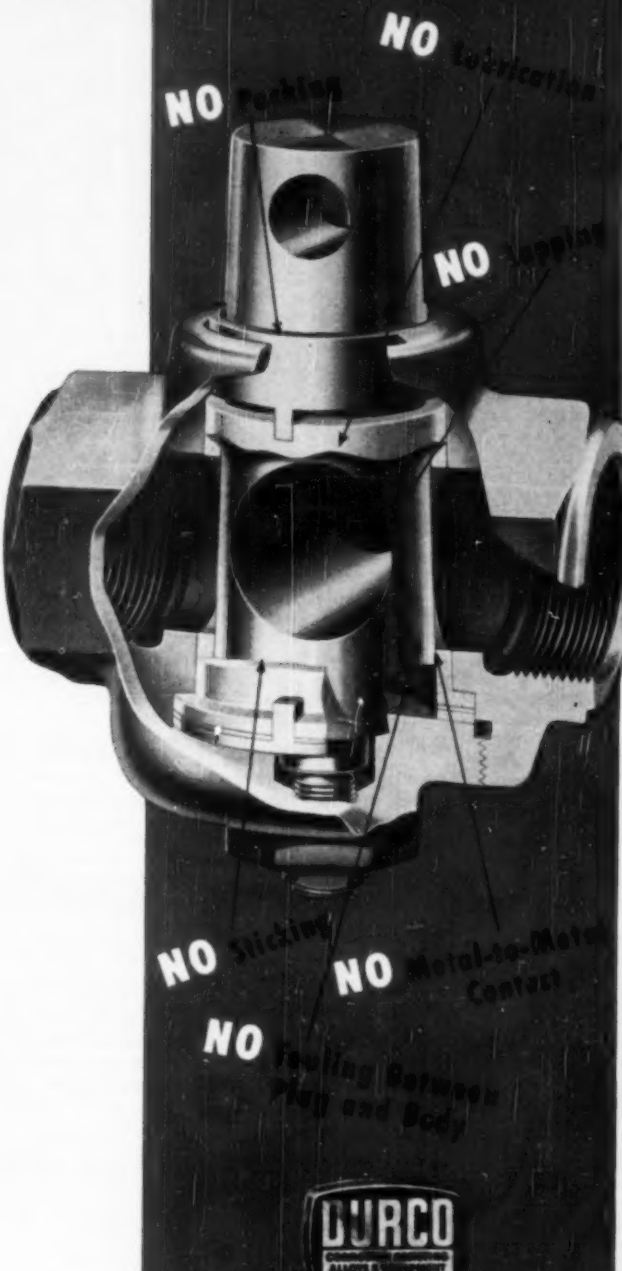

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lead or lead covered steel; and the shaft lead covered steel. A typical gas fan is illustrated. From the fan the cooled gas is discharged through a four-way lead plug cock and passed into a series of two or more acid towers more than 100 ft. high filled with broken limestone. Large lead ducts 2 to 4 ft. in diameter, assembled in the field, are used to conduct the gas from the top of one tower into the base of the other, again through a four-way lead plug cock. A lead duct between two absorption towers and plug cock and cast lead damper are illustrated.

Acid sulphite is generated in the tower as sulphur dioxide reacts with the limestone in the presence of a fine spray of water passing downward through the system countercurrent to the gas. Calcium bisulphite liquor is produced containing an excess of free sulphur dioxide. In the parlance of the pulp manufacturer, the "free" sulphur dioxide is the sum of that as sulphurous acid and that portion which requires alkali to convert from an acid sulphite to a neutral sulphite.

Waste carbon dioxide, moisture and traces of sulphur dioxide are discharged through a valve to the atmosphere. Water with acid and finished raw acid are redistributed to the towers by a six-way lead plug cock. The water and acid lines to and from the towers are lead. To permit recharging the towers with limestone, the flow of gas and water is alternated each day by manipulating the gas and acid plug valves.

Raw acid is delivered from the acid plant through lead piping to the reclaiming tank. In this tank the raw acid is fortified by cool, strong gas relieved from the digesters. From here the acid flows into storage tanks through lead piping. Storage acid temperature is normally about 90 deg. F. and the pressure close to atmospheric. Since a small amount of sulphuric acid is formed during the cooking process and all is not absorbed in the reclaiming system, lead is by far the best material to handle the excess gas from the tanks. Where reclaiming towers are used, they are generally constructed of chemical tile in a steel shell lined with 8 or 10-lb. sheet lead to protect the steel against attack by seeping corrosives. In the majority of plants, wooden acid storage tanks are used. It is common practice to cover the iron hoops on wooden acid tanks with relatively thin walled lead piping and the turnbuckles with 4-lb. sheet lead to prevent their corrosion by acid seepage.

In the cooking process the acid sulphite and wood chips are brought together in a digester lined with acid resistant brick set in cement composed of litharge (PbO), sand and glycerine. Temperatures vary from 250 to 350 deg. F. and pressures range from 75 to 125 psi. Here again a lead lining between the brick and shell of the digester is often used as an impervious corrosion-proof lining to protect the steel. The combination of brick and lead is being used successfully in other chemical operations up to 900 deg. F. On the top of the digester 1 in. thick antimonial lead covers 36 in. in diameter are giving good service. In some instances, dished steel covers are used lined with 16 to 20-lb. lead. Lead digester relief valves, usually 2 to 4 in., are also being used successfully on digester covers. McKay and Worthington quote a virtually zero corrosion rate for lead exposed in four different sulphite digesters where the temperatures ran anywhere from 275 to 295 deg. F. The solution carried 3.6 to 4.4 percent free sulphur dioxide and the pressure ran 125 to 146 psi.

Two methods of cooking, direct and indirect, are widely used. In the direct method, the digester is heated directly with steam. The indirect process, on the other hand, utilizes vertical or horizontal digesters equipped with hard lead steam coils. The cooking time is about 58 hr. and the maximum temperature and pressure are 266 deg. F. and 60 psi. A newer innovation, lead covered copper coils, makes operation at much higher temperatures practical.

The maximum safe working steam pressure for antimonial lead coil (6 percent Sb) is 38 psi. steam gage pressure (284 deg. F.) and for chemical lead it's 55 psi. (302 deg. F.) but lead covered copper coil may be safely operated up to 150 psi.

Cements

RAYMOND B. SEYMOUR, *The Atlas Mineral Products Co., Mertztown, Pa.*

Acid pulping brings about the major corrosion problem in the pulp and paper industry but fortunately, these can usually be solved through the use of modern corrosion resistant cements. Some plants still use leadlined equipment for digesters but such are being rapidly replaced with more modern design, primarily because of the high coefficient of expansion and creeping of lead.

Modern design usually consists of ceramic linings joined with acid proof cement. Litharge-glycerine cements were formerly standard for joining acid brick in sulphite digesters, acid accumulators and blow pits. However, since the effectiveness of this type of cement was dependent upon the formation of insoluble calcium salts, its utility was limited to the calcium bisulphite process. Soluble acid pulp processes require phenolic or furfuryl alcohol type cements. Sulphur cements are also resistant to sulphurous acid liquors but are satisfactory only at temperatures below 200 deg. F.

A typical sulphite plant consists of an absorption tower, such as a Jenssen tower, a reclaiming tower, an acid storage tank and a digester. The acid storage tank and reclaiming tower have often been constructed of wood but rubber-lined steel tanks are more satisfactory since they can be used at higher temperatures. Economy considerations require that the acid be as warm as possible and rubber-lined tanks are satisfactory at temperatures at least 30 deg. F. higher than wooden tanks. Still higher temperatures can be employed if a brick sheathing is used to protect the rubber-lined equipment. Such brick, of course, is joined with suitable acidproof cement.

Some processes use a brick lined spherical digester but today's typical digester is a tall cylindrical vessel with conical or dome shaped top and conical bottom. The customary digester has a diameter in the order of 15 ft. and is about 50 ft. in height.

For calcium-base sulphite cooking, one course of 2½ or 3 in. brick laid with a litharge-glycerine cement joint and backed by portland cement has been satisfactory and modifications of this construction have been used for the heavier linings. However, with the soluble base pulping, resin base cements must be used for joining the brick in the course in contact with the cooking process. A fairly rapid

(Continued)

Evaluation of Cements for Acid Pulping Uses.

Cement	Resistance to Ca Bisulphite	Resistance to Sol. Sulphite	Effectiveness at temp. above 200 deg. F.	Absorption, %	Adhesive Strength	Coef. of Expansion $\times 10^{-6}$
Furfuryl alcohol	Excellent	Excellent	Excellent	<0.5	Excellent	6
Phenolic	Excellent	Excellent	Excellent	<0.75	Very good	7
Sulphur	Excellent	Excellent	Poor	<0.5	Good	8
Silicate	Fair	Poor	Excellent	10	Very good	6
Litharge-glycerol	Good	Poor	Good	5	Very good	9
Portland	Poor	Poor	Good	5	Good	6

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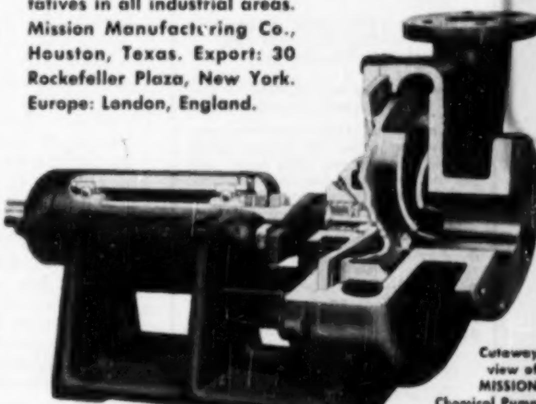

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setting furfuryl alcohol cement has been introduced for this specific purpose so that no delays are encountered while waiting for the cement to set.

Since the floor areas are usually not subjected to temperatures above 200 deg. F., the bricks on these floors can be joined satisfactorily with a plasticized sulphur cement. However, for best results, furfuryl alcohol base cements are advocated.

The physical and chemical properties of corrosion resistant cements of greatest interest to acid pulping are shown in the table.

Rubber

James P. McNamee, *U. S. Rubber Co., Providence, R. I.*

In the production of chemical pulp by the acid or sulphite process, wood chips are digested with a liquid which consists essentially of a calcium bisulphite solution containing free sulphur dioxide. The bisulphite solution is manufactured by reacting sulphur dioxide gas, obtained by burning sulphur in air, with either a water suspension of lime (milk-of-lime) or solid limestone in large towers.

This acid liquor is very corrosive and must be handled in equipment constructed of special materials capable of resisting its corrosive action. One of these materials is rubber lined steel. Soft rubber compositions are satisfactory with straight calcium and magnesium bisulphite solutions, but the presence of free sulphur dioxide in most sulphite liquors requires the use of hard rubber linings.

Hard rubber has not been extensively used as a material of construction in the sulphite plant due to the relatively high operating temperatures involved in most of the process lines. Regular hard rubber linings can be used at a maximum temperature of 180 deg. F. and special compositions are available for temperatures as high as 220 deg. F.

Within these temperature limitations hard rubber lined steel should be considered for process and storage tanks, pipe, fittings, valves, pumps, agitators, fans and duct-work. A $\frac{1}{8}$ in. thickness of lining is usually recommended for handling sulphite liquors. The rubber is applied to the metal equipment in the form of unvulcanized sheets which are then vulcanized by means of steam pressure to form a dense layer of hard rubber uniformly adhered to the steel foundation. This layer of hard rubber will adequately protect the steel from the corrosive action of the bisulphite solutions.

Plastic pipe of the Uscolite type is resistant to sulphite liquors up to a maximum service temperature of 160 deg. F. This pipe can be ordered in stock lengths and cut to size and threaded as desired. Since a complete line of fittings is available, this material should find wide applications where chemically resistant pipe is desired.

Iron and Steel

Albert W. Spitz, *Reiter Engineering Co., Philadelphia, Pa.*

Arthur E. May, *Moore and White Co., Philadelphia, Pa.*

Iron and steel are widely used for pulp wood and sulphur handling prior to the preparation and use of the acid cooking liquor.

Log conveyors, barkers, chippers, chip screens and elevators of low carbon steel and cast iron construction are quite satisfactory.

Sulphur melters, burners and burner gas coolers are also fabricated of these metals. Sulphur dioxide piping may be of cast iron or steel if the gas is dry, or the temperature high enough to prevent condensation. SO_2 and bisulphite solutions require the use of corrosion resistant materials.

Brick lined steel digesters are extensively used; however, the present trend is toward the use of more resistant alloys without brick lining.

Iron and steel are not suitable for sulphite pulp blow pits.

Knotters and screening equipment prior to the actual paper making operations may be of iron or steel construction.

High-Silicon Irons

Walter A. Luce, *The Duriron Co., Dayton, Ohio*

The high-silicon iron alloys, Duriron and Durichlor, find no application in the handling of sulphite solutions in the pulp and paper industry. Sulphurous acid and the various sulphites are among the few corrosives which attack these alloys and this accounts for their lack of application.

Nickel, Nickel Alloys

H. O. Teeple, *International Nickel Co., New York, N. Y.*

Cooking liquors used for acid pulping may be calcium, magnesium or ammonium base bisulphite liquors. Since these acid pulping liquors involve the use of solutions containing free sulphur dioxide, Monel, nickel, Inconel and Ni-Resist find little application. Other alloys, particularly cer-

tain of the austenitic stainless steels are more resistant to corrosion by these cooking liquors, hence, are preferred for acid pulping service.

To indicate the relative position of Monel, nickel, Inconel and Ni-Resist in comparison with other more suitable materials, the following corrosion data are shown.

Plant Corrosion Test in Collector Ring in Calcium Bisulphite Pulping Digester

Duration of test 652 hr., temp. 141 deg. C. max., 60 deg. min.

Material	Corrosion Rate, In. per Yr.
Type 316	0.0002
Type 317	0.0002
Type 309	0.0007
Inconel	0.023
Monel	0.19
Ni-Resist	1.0

Plant Corrosion Test—Specimens Attached to Digester Cover

28 day test, temperature 291 deg. F. max., 143 deg. F. min., 7.87% total SO_2, 6.82% free SO_2, 1.05% combined SO_2.

Material	Corrosion Rate, In. per Yr.
Type 316	0.0001
Type 317	0.0001
Hastelloy C	0.0005
Worthite	0.0001
Monel	0.62
Nickel	0.79
Inconel	0.01
Ni-Resist	0.98
Cast iron	1.8
Mild steel	10.9

It is to be noted, however, that once the spent acid cooking liquor has been removed from the sulphite stock, Monel, nickel, Inconel and Ni-Resist are quite useful as described in part I of this symposium, stock handling.

Chlorimets

Walter A. Luce, *The Duriron Co., Dayton, Ohio*

The Chlorimet alloys find no application in the sulphite process for making pulp.

Stoneware

M. J. Winson, *General Ceramics and Steatite Corp., Keasbey, N. J.*

In the acid pulping operations encountered in the pulp and paper industry, corrosion is quite a problem. This problem has been effectively combated by the use of corrosion-proof chemical stoneware and chemical porcelain, and in many instances, plastic; pipes, valves, fittings, pumps and vessels. Cast modified phenolic equipment known as Kemplas #1 is resistant to the sulphurous acid solutions used in acid pulping. For corrosion-proof service at any concentration up to 250 deg. F., modern high strength chemical porcelain is superseding the weaker chemical stoneware.

(Continued)

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Durimet pumps handling sulphurous acid in the make-up of sulphite cooking liquor.

Durimet 20

WALTER A. LUCE, *The Duriron Co., Dayton, Ohio*

Stainless steels are commonly accepted as the most suitable alloys for use in the sulphite process for pulp and paper production and, therefore, find wide application in this industry in both the cast and wrought forms. The need for these alloys results from the continuous handling of sulphurous acid and various sulphite solutions which are often encountered at high concentrations and elevated temperatures. Although the conventional 18 percent chromium-8 nickel alloys and the 29 percent chromium-9 nickel alloys find the greatest application, there is a definite advantage in many services for a higher alloyed stainless steel such as Durimet 20.

The pulp and paper industry has always been progressive and this outlook has been reflected into their continual selection of more suitable and more economical alloys in the pulping stage. Sulphite pulping is, of course, particularly severe and it is in this type mill that continual progress in materials was necessary. Numerous corrosion data have been published on the comparative resistance of the various stainless alloys, but these data often do not show any superiority of the highly alloyed stainless steels, such as Durimet, over the more conventional stainless alloys. However, it has been found from experience that other important factors, such as solution velocity or erosion, cannot be estimated from static tests. Therefore, Durimet 20 is being applied in these services to a greater extent as pumps, valves and special fittings. In fact, it is being used in certain services where a supposedly satisfactory service life from these other alloys was being received. Its selection re-

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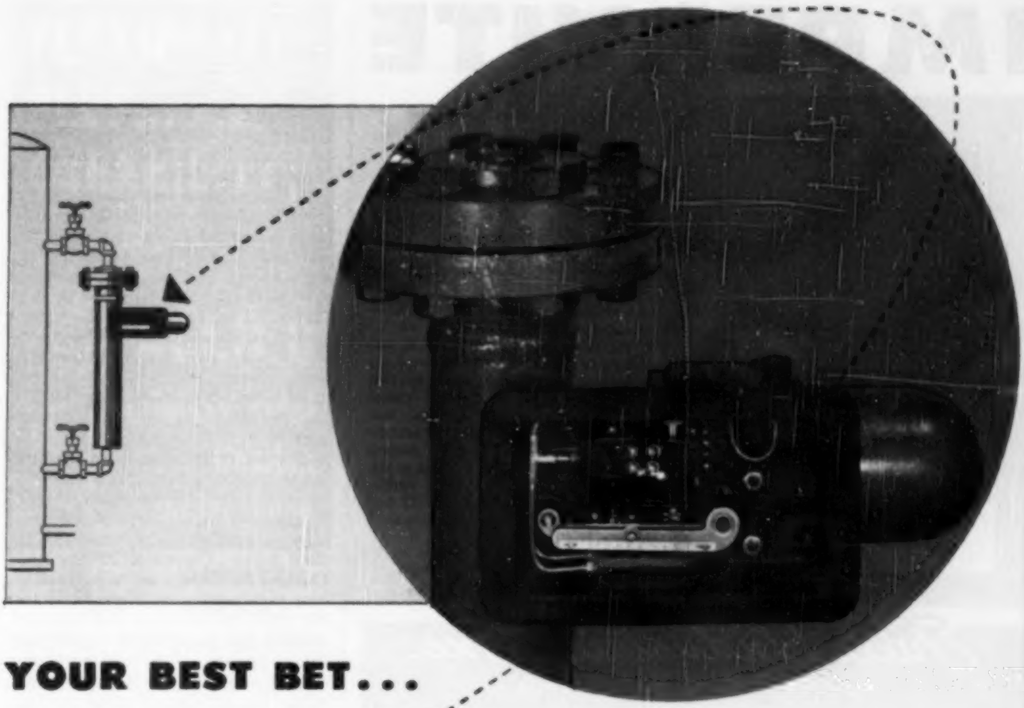

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Durimet 20 is a highly alloyed stainless steel with a nominal chemical composition in the cast form of 29 percent Ni, 20 Cr, 2 Mo, 3.5 Cu, 1 Si, 0.07 C max. and balance Fe. It is available in the form of castings and equipment made from castings, such as pumps, valves, fans, ejectors, jets, and mixing nozzles. The wrought form of this alloy is produced by the Carpenter Steel Co. under the name Carpenter Stainless No. 20. Presently, the wrought alloy is available in the form of wire, rod, bar, strip, sheet, plate, welded pipe and tubing. Welding electrodes in the Durimet 20 analysis are also available.

The use of Durimet 20 in sulphite pulping extends throughout the acid plant and the digester room. Many of the present applications for this alloy in both these locations will be cited below. Carpenter 20 pipe and Durimet 20 fittings are being applied in a test installation at one plant for the pond type coolers handling hot sulphur dioxide gas from the combustion chamber. This service is extremely severe at certain locations where the presence of small percentages of sulphur trioxide and moisture at a temperature just below the dew point result in the formation of sulphuric acid. The temperature involved is very high. After a substantial test duration, this alloy appears to offer acceptable resistance where previous alloys failed. Durimet 20 and Carpenter 20 have also found application in the fan which handles the cooled sulphur dioxide gas from the cooler to the absorption or acid towers. In the spray type cooling towers, Durimet 20 nozzles are also being used.

Durimet pumps and valves are being applied for recirculating both the weak and strong acid solutions from the weak and finished acid towers, respectively. The accompanying illustration typifies a number of pumps in such an installation. The two pumps at the right are alternately handling weak and strong sulphurous acid and have been in operation in the production of calcium bisulphite since 1941. Other Durimet pumps in this same type service are providing well over 15 years' continuous service. The Durimet pump at the left of this same illustration transfers a 4 percent acid solution to storage. Durimet "Y" valves are being successfully used in the acid plant for handling these same solutions with good success. It has been reported that Durimet is espe-

(Continued)

cially desirable in the production and use of the ammonium bisulphite liquor.

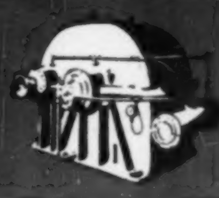
The Durimet 20 alloy is also finding application in the digester room. Not only are Durimet pumps and valves being used to handle the cooking liquor to the digesters, but Durimet 20 castings are also utilized for critical parts in the digester itself. Castings in Durimet include top sleeves, Panzl and other type strainers, test fittings, elbows, cast pipe, steam inlets and nozzles, bottom sleeves, blow-off fittings and others. Relief valves have been made from Durimet with the top relief valve being especially critical since it handles a corrosive combination of sulphurous acid and products from the wood, both under oxidizing conditions and at very high temperatures. Durimet "Y" valves and plug valves are very well adapted for this severe service. Durimet valves have found application as test cocks on the digesters. The recently announced Durco Type F valve with Teflon liner is extremely well suited for this service and in test installations, it is providing superior service over other valves previously used.

The Durimet 20 alloy has found application as circulating system pumps. Pumps in this alloy are also being applied for handling spent cooking liquor for leveling off the pulp in the blow pits. Durimet is finding application as a material for the target plates in the blow pits.

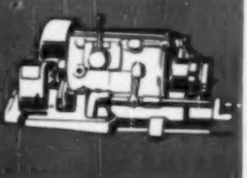
The above services illustrate the uses to which Durimet 20 is being applied in sulphite pulping. As noted previously, the Durimet 20 alloy is usually selected where high velocity conditions exist, such as in pumps and valves or where the presence of small percentages of sulphuric acid are encountered. It is suspected by many experts that small percentages of sulphuric acid may be encountered in the digester system, especially during shut-downs and if this is the case, the value of Durimet 20 may be more desirable than first anticipated. However, it should be pointed out that even Durimet 20 has its limitations in sulphuric acid service and it should be carefully considered for the more severe conditions.

Durimet 20 also finds application in sections of the sulphite process other than the acid plant and digester room. For instance, waste calcium bisulphite liquors are processed by a few companies for the byproducts they contain. Durimet 20 pumps are being used successfully in such operations.

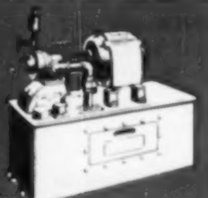
—End



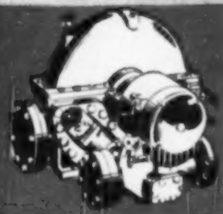
SPEED REDUCER



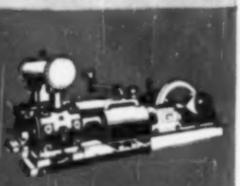
HEAD STOCK GEARS



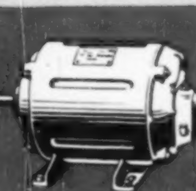
HYDRAULIC SYSTEM



AUXILIARY TURBINE



COMPRESSOR



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Now better than ever

NEW

STANOIL
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Brings two new benefits to wide range of jobs

For 14 years, STANOIL Industrial Oils have proved their ability to handle a wide variety of jobs in midwest plants. Now, these established products have been made better than ever! They offer these new and important savings in an even wider variety of industrial equipment.

1 LONGER OIL LIFE

Because they have greater oxidation stability, the new STANOILS stand up under high temperatures of operation, maintain low acidity for longer periods of service which helps keep oil systems free from deposits caused by oil oxidation.

2 GREATER PROTECTION against RUST

A corrosion inhibitor of the most advanced type has been added to all grades of the new STANOILS that benefit by such an additive. This inhibitor prevents corrosion trouble by "plating out" on surfaces that tend to rust. In such severe service as paper-machine and steam-turbine lubrication, new STANOILS have put an end to rust and corrosion troubles.

At the left are shown several types of equipment in which the new STANOILS can save you money and maintenance time. A Standard Oil lubrication specialist will help you find still other applications where versatile STANOILS can replace many special-purpose oils. You can reach this man quickly and easily through your local Standard Oil Company (Indiana) office. Contact him today. Or, if you wish, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

HIGHLY REACTIVE PHOSPHORIC ANHYDRIDE...

another VERSATILE VICTOR CHEMICAL

The properties of Victor phosphoric anhydride make it useful in many manufacturing processes. The following applications are typical and show the variety of uses which have been developed:

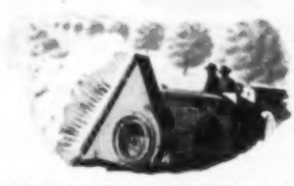
- → **GAS DRYING AGENT**
- → **CATALYST**
- → **REAGENT IN METHYL METHACRYLATE RESINS**
- → **ORGANIC PHOSPHATES**

If you are looking for ways to increase efficiency and reduce production costs, why not consider the application of Victor phosphoric anhydride? Write today for quotations, technical data, or samples.

Typical Reactions of Victor Phosphoric Anhydride

$$RCOOH + R'OH + P_2O_5 \rightarrow RCOOR' + 2HPO_3$$
$$R_2O + P_2O_5 \longrightarrow 2RPO_3$$
$$3R_2O + P_2O_5 \longrightarrow 2R_3PO_4$$
$$3ROH + P_2O_5 \longrightarrow R_2HPO_4 + RH_2PO_4$$

GAS DRYING AGENT—RADIO TUBES



ORGANIC PHOSPHATES—INSECTICIDES

CATALYST—ASPHALT IN IRRIGATION DITCHES

REAGENT IN METHYL METHACRYLATE RESINS

VICTOR CHEMICAL WORKS

141 WEST JACKSON BOULEVARD • CHICAGO 4, ILLINOIS

A. R. Maas Chemical Co., Division
4570 Ardine Street, South Gate, California

DEPARTMENT OF THE MONTH

Names in the News

(*Continued from page 116*)

Paul Kite. Manager of the development department, Dorr Co., Stamford, Conn.; has been assistant manager. Joined Dorr in 1921; graduate of Delaware College and MIT.

William A. Hamor. Assistant director of Mellon Institute to receive the 1950 award of the Pittsburgh section of ACS for outstanding service to chemistry. Editor of society's Chemical Monographs since 1947. Pitt graduate.

S. W. Martin. General manager of the engineering and development department, Great Lakes Carbon Corp., New York. Joined the company in 1949 as associate director of research. Former employers: Portland Gas and Coke Co., Armour Research Foundation, National Lead Co.

H. K. Ihrig. Vice president in charge of research, Allis-Chalmers Mfg. Co., Milwaukee. Recently resigned vice president and director of laboratories of Globe Steel Tubes Co., Milwaukee, after 17 years service. Awarded 1947 Robert W. Hunt medal by AIMME for best paper published on iron and steel research; cited in 1949 by the University of Wisconsin college of engineering for contributions to the field of metallurgy. Studied at Carleton College, University of North Dakota, University of California (Ph.D., 1923).

Austen W. Boyd. In charge of the chemical process development Waterford, N. Y., group of General Electric's chemical department. Joined GE in 1946 as a chemical engineer; previously a research assistant for the Tidewater Association. Graduate of Cornell, 1943.

Alphonse Pechukas. Engineering manager for the chemicals division of General Electric's chemical department. Has been director of research for the Columbia Chemical Division of Pittsburgh Plate Glass Co., Barberton, Ohio. Studied at the University of Chicago.

Claude W. Pierce. Superintendent of water disposal, a newly-created post in the production department of General Petroleum Corp., Los Angeles. To work with firm's three production divisions in California on problems involved in the disposal of oil field wastes and design and construction of injection plants for underground disposal of salt water. Veteran of 24 years with General Petroleum; since 1942, resident engineer for the production department's southern division. Studied at the University of California.

Virgil C. Williams. Associate director of General Aniline & Film Corp.'s central research laboratory, Easton, Pa. To head up chemical engineering development. Formerly head of the chemical engineering department at Northwestern University.

James R. Donnalley. Facilities engineer assigned to silicones for the manufacturing division, chemical department, General Electric Co. Has been Waterford plant manager since 1948.

Lyman H. Allen, Jr. Chief engineer for Foster D. Snell, Inc., New York chemical and engineering consultants. Has been assistant chief design engineer, American Viscose Corp., Philadelphia. Graduate of MIT.

Alfred M. Price. Chief engineer of Quaker Oats' new Omaha furfural plant. Graduate of Princeton, joined company as engineering trainee in 1946.

Joseph Sumner Bates. New director of the chemical division of the National Production Authority. President of Bates Chemical Co. since 1924. During World War II: Lt. Col. in the Ordnance Department assigned to export control operations; later connected with WPB's chemical division; executive vice president of General Aniline & Film Co. when it came under Federal control. Chief of a special mission for the Secretary of War to survey I. G. Farben properties in Germany in 1945. Began three-year term as president and director of Ciba Pharmaceutical Products in 1947. Studied chemistry at Yale: Sheffield Scientific School, 1912; Ph.D., 1915.

J. S. Bates

R. P. Soule

Roland P. Soule. Chemical engineer turned banker. Newly elected vice president of Irving Trust Co. in charge of the research and planning division. Director of the American Machine and Foundry Co., International Cigar Machinery Corp. and the American Management Association; member of the advisory board of *Chemical Industries*. Alumnus of the University of Rochester and Columbia's chemical engineering department (Ph.D. 1922). Frequent lecturer at Columbia and NYU and contributor to technical journals. Previous positions: vice president in charge of research and development of American Machine and Foundry

(*Continued*)

Olaf A. Hougen

(*Continued from page 116*)

Since 1920 his teaching connection with Wisconsin engineering has been almost uninterrupted. Summers he does industrial consulting and in 1937 he served as professor of chemical engineering at Armour Institute of Technology. During World War II he went to work for the WPB—length of service: 4½ years; total earnings: \$4.33.

With Professor K. M. Watson, he coauthored "Industrial Chemical Calculations" in 1931 and 1936, and the three-volume "Chemical Process Principles" during the 40's. "'Industrial Chemical Calculations' was written as a result of a senior inspection trip. As students Dr. Watson and I were trying to write a report equal to the prewar standards of the Senior Inspection Trip Report of the Ohio State University chemical engineering department. ICC was the result. This book has also been labeled 'Arithmetic for Dumb Chemists'." The arithmetic book along with many other published articles won him the 1944 William H. Walker award of the AIChE for outstanding contributions to chemical engineering literature.

Professor Hougen plays golf "whenever I can induce some beginner to play along." He shoots in the high 90's but appears to get more joy out of the game than Sam Snead. Recently a new hobby has been making inroads—he pays 50 cents an hour for the privilege of baby sitting with his granddaughter.

Co.; technical advisor, Tri-Continental Corp.

Erwin Di Cyan. New president of the Association of Consulting Chemists and Chemical Engineers, New York. Member of the firm, Di Cyan & Brown, New York consulting chemists.

Earl D. Stewart. New vice president of the Association of Consulting Chemists and Chemical Engineers, New York. Director of research, Schwarz Laboratories, New York.

Robert S. Aries. New treasurer of the Association of Consulting Chemists and Chemical Engineers, New York. Member of the firm, Robert S. Aries & Associates, chemical engineering consultants of New York.

Irving Langmuir. Winner of the John J. Carty Gold Medal and Award conferred by the National Academy of Sciences for noteworthy contributions to the advancement of science. Retired associate director of the General Electric Research Laboratory. Instrumental in development of modern electric light, high-vacuum radio tube; studied electron emission, gaseous discharges, oil films on water. Winner of Nobel Prize in Chemistry, Faraday Medal.

L. B. Parsons

N. T. Joyner

L. B. Parsons and **N. T. Joyner.** Assistant directors of research for Lever Bros. Co., New York. Mr. Joyner (with Lever since 1932) to direct administrative and technical services sections. Mr. Parsons (with the company since 1939) to direct the newly formed product development and basic laboratories sections. To be located at the firm's research headquarters in Cambridge, Mass.

Gordon W. Anderson. To work on mechanical aspects of chemical problems at Bjorksten Research Laboratories. Graduate of University of Wisconsin college of engineering, 1950.

Marion W. Boyer, formerly Esso's vice president in charge of manufacturing, has taken on the top management post on the staff of the Atomic Energy Commission. Said Commission Chairman Dean, "He brings . . . broad executive and technical experience and a record of outstanding success as the director of large-scale manufacturing and research operations. His record as a working scientist and an executive in development insures effective teamwork with research men as well as production operators . . .".

M. W. Boyer

Blue-eyed, sandy-haired general manager Boyer commented that while it was not easy to leave the associates of years (23) in Esso Standard, he is eager to enter on the new work. He has already moved to Washington with his wife and young son; his most recent post at Esso had stationed him in New York. Until 1949, however, he was at the company's large, complex, Baton Rouge refinery—much of the time in direct charge.

A native of Muncie, Ind., Mr. Boyer took bachelor's and master's degrees in chemical engineering from MIT then served there in the laboratory of applied chemistry. He started at Baton Rouge in 1927 as assistant and associate in the research laboratory of applied chemistry. Subsequently, his positions in chronological order were: director of laboratories, head of the technical division, general plant superintendent, director of Standard Oil of Louisiana and assistant general manager of manufacturing, executive vice president and general manager of the Louisiana company. In 1945 he became a vice president and director in charge of Louisiana operation of Standard Oil Co. of N. J.

Edward G. Appel. To apply metallographic techniques in plastics at Bjorksten Research Laboratories. Formerly with Girdler Corp. and its affiliate, Tube Turns, Inc., Louisville, Ky. Graduate of the University of Illinois.

Wayne A. Sisson. Cellulose expert of American Viscose Corp. starts a four-year term as collaborator of the cotton fiber division, Southern Regional Research Laboratory, New Orleans.

Cyde McKinley. Chemical engineering assistant to manager of the special products department and sulphur colors and textile auxiliaries department, Grasselli Works Division, General Aniline and Film Corp. Transferred from company's central research laboratory, Easton, Pa. Studied at University of Michigan (Ph.D., 1943).

Ralph C. Barley. Senior chemical engineer, chemical engineering department, Grasselli Works Division, General Aniline and Film Corp., Linden, N. J. Graduate of Drexel Institute, 1941.

William A. Ellis. Special products department, Grasselli Works Division, General Aniline and Film Corp. Studied at Bucknell and New York University.

Charles A. Barg. Control chemist, sulphur colors department, Grasselli Works Division, General Aniline and Film Corp. Graduate of Rensselaer Polytechnic Institute, Troy, N. Y., 1950.

John C. Rabetz. Project engineer, engineering department, Grasselli Works Division, General Aniline and Film Corp. Graduate of Brooklyn Polytechnic Institute.

Kenneth L. Sayre. To do experimental and developmental work on electrochemical projects at Bjorksten Research Laboratories in Madison, Wis. Previously with Standard Ultramarine Co.

Jean-Claude Landau. Research staff, Atlantic Chemical Corp., Passaic, N. J. Has been at the University of Zurich, Switzerland doing graduate work and research in organic chemistry in the laboratories of Nobel prize-winner, Paul Karrer. Graduate of MIT.

Nicol H. Smith. Executive director of Franklin Institute laboratories for research and development; has been director of research operations since 1949. Studied at Drexel Institute of Technology, University of Pennsylvania (Ph.D., 1927). Joined the institute in 1932 as associate director in charge of chemistry.

C. T. Chase. Associate director for chemical engineering and physics, Frankline Institute laboratories for research and development. Degrees from Princeton, California Institute of Technology and New York University. Member of physics department at NYU, 1931 to 1944.

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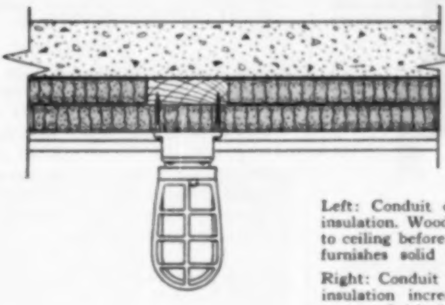
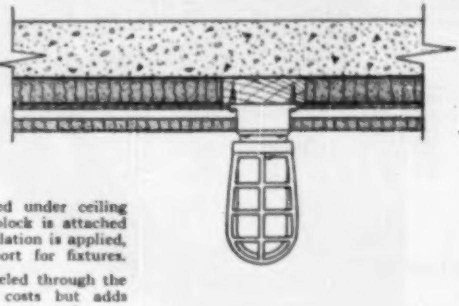




Left: Conduit carried under ceiling insulation. Wooden block is attached to ceiling before insulation is applied, furnishes solid support for fixtures.

Right: Conduit tunneled through the insulation increases costs but adds to neat finished appearance of room.

We have been asked . . .

"HOW DO I HANG ELECTRICAL FIXTURES FROM A CORK CEILING?"

"I am planning to build a large freezer room, to be insulated with 6" of corkboard," writes a man about to enter the frozen food distribution business. "I have heard that dropping outlets through the ceiling reduces the efficiency of the insulation. Is this true, and if it is, how do I hang electrical fixtures from a cork ceiling?"

HERE'S THE ANSWER:

Dropping electrical outlets through a freezer room ceiling violates a cardinal principle of cold room construction; that is, the insulation envelope should be broken only at a minimum number of places. Metal conduits are good conductors of heat and warm air. Moisture in the air flowing into the room through the break made by the conduit will condense, turning to ice in the surrounding insulation, and on the outer surfaces of electrical fixtures. The same thing happens inside the conduit. Over the years, this condensation and freezing is bound to have a damaging effect on both the insulation and the electrical wiring.

Freezing in and around conduits and fixtures can be avoided by bringing all electrical wiring in through one conduit, sealed into the wall. Warm air can be kept from flowing through the conduit with a special sealing condulet outside the wall. In the room, leads are distributed under the ceiling. The problem of holding the fixtures to the cork ceiling is solved by the use of wooden blocks, fastened to the ceiling in the first layer of insulation. Blocks should be at least 6" x 6" and as thick as the first layer of insulation. When the second layer of insulation is applied, the location of the blocks can be indicated with chalk. The electrician can then drive lag screws into the wooden blocks to support the electrical fixtures.

This problem is not difficult, but if ignored can cause trouble on the job. Like so many aspects of low-temperature insulated construction, the best electrical wiring system can be assured by careful planning before the job begins. Armstrong engineers will gladly help you plan your next low-temperature insulation work.

SEND US YOUR QUESTIONS: *If you have any questions on the construction of low-temperature facilities, please do not hesitate to write to us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Company, 3312 Concord St., Lancaster, Pa.*

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

becoming associate professor and acting head of the department. Associate professor at MIT, 1944-1946.

Robert H. Seavy. Assistant director of the graduate school and the industries training school of Stevens Institute of Technology, Hoboken, N. J., with the title of assistant professor. Connected with the Stevens teaching staff in the department of chemistry since 1942. Studied at Penn State and Stevens.

Edward W. Gamble, Jr. Assistant to the Monsanto vice president and director of industrial preparedness; to be stationed in Washington, D. C. Joined Monsanto in 1946 as assistant to the president; in 1947 directed rehabilitation at Texas City and then went to the Merrimac Division as director of textile chemicals.

Fred M. Berkey. From manufacturing superintendent of Monsanto Chemical Co.'s plant at Monsanto, Ill., to engineering sales department as senior engineer. To design chlorine plants. Joined the Illinois plant in 1941 as assistant operating superintendent; served as operating superintendent of the chlorine division and as service superintendent. Graduate of the University of Kansas.

Joseph F. Stickley. Transferred to development department of Monsanto's organic chemicals division, from Monsanto, Ill., plant where he was assistant manager. To review, from an engineering standpoint, development items before they are far enough along to justify actual plant exploration. Graduate of Washington University; joined Monsanto in 1920.

Osborne Bezanson. President and member of the board of directors of Chemstrand Corp., jointly owned by American Viscose and Monsanto. To supervise building of a multi-million dollar synthetic fiber plant at Decatur, Ala. Resigned vice president and member of Monsanto's executive committee.

S. S. Michels. Transferred from the B. F. Goodrich Chemical Co. operated synthetic rubber plant at Port Neches, Tex., to the government's copolymer plant at Institute, W. Va. Promoted from senior chemical engineer at Port Neches to technical manager at the com-

pany's newly acquired plant in West Virginia.
cultural uses.

Albert E. Marshall. Resumed practice as a consulting chemical engineer, Industrial Trust Bldg., Providence, R. I. Past president AIChE and Rumford Chemical Works. Most recently, vice president in charge of the Rumford Division, Heyden Chemical Corp.

A. E. Marshall M. T. Harrington

Marion T. Harrington. President of A. & M. College of Texas. Since 1946, assistant to the dean of the college. Alumnus of A. & M. and Iowa State (Ph.D., 1941); further graduate studies at MIT, Universities of Michigan and of Southern California.

Sidney Siegel. Associate technical director of the atomic research department, North American Aviation, Inc., Los Angeles; to assist nuclear reactor studies being conducted for the AEC. Formerly manager of the atomic power division, physics department, Westinghouse Electrical Corp.

Calvin A. Buehler. First recipient of the new Southern Chemist Award. Heads University of Tennessee's department of chemistry. Joined faculty in 1922; graduate Ohio State (Ph.D). Award is sponsored by the Georgia section of ACS and the Southern Association of Science and Industry.

Robert A. Hoffer. Engineering manager for the plastics division of General Electric's chemical department. Formerly with E. I. du Pont de Nemours: technical representative, Chicago area; sales representative, Cleveland area. Graduate of Purdue in 1941.

John T. Castles. Manager of General Electric chemical department's silicone plant at Waterford, N. Y. Started with GE as chemical engineer at Waterford in 1947. Graduate of MIT.

Frank R. Simpson. Director of research and development for the

(Continued)

NAMES IN THE NEWS, *cont.* . .

Kuljian Corp., Philadelphia. For the past eight years, directed research projects for Franklin Institute of Philadelphia. Previously worked on design and engineering for Westinghouse, Baldwin Locomotive, De Laval Steam Turbine.

Robert C. Hills. Vice president, Freeport Sulphur Co., New York. Started with Freeport in 1934 as a chemist at the Louisiana sulphur operations. Manager of Cuban subsidiary's metallurgical plant during World War II. Assistant to the president, 1946; director of development, 1950.

Raymond Szymanowitz. Director of Acheson Colloids Ltd., London, affiliate of Acheson Colloids Corp., Port Huron, Mich. Started with the Port Huron corporation in 1924; technical director since 1938. Graduate of Cooper Union; part-time instructor in department of chemical engineering at Cooper Union, 1928 to 1941.

R. Szymanowitz

E. W. Rugeley

Edward W. Rugeley. Technical di-textile fibers department in South rector of Carbide and Carbon's new Charleston, W. Va. Connected with Carbide since 1934, most recently as superintendent of research and development at South Charleston. Holds a number of patents on synthetic fibers. Doctorate from Yale.

George H. Law. Associate director of research for Carbide and Carbon; has been assistant director. Graduate of Yale; joined Carbide's research staff in 1929. Worked on development of a new process for making ethylene glycol.

Franklin Strain. Acting director of research in charge of Columbia Chemical laboratories at Barberton, Ohio, of Pittsburgh Plate Glass; formerly assistant director. Studied organic chemistry at Ottawa University and University of Kansas.

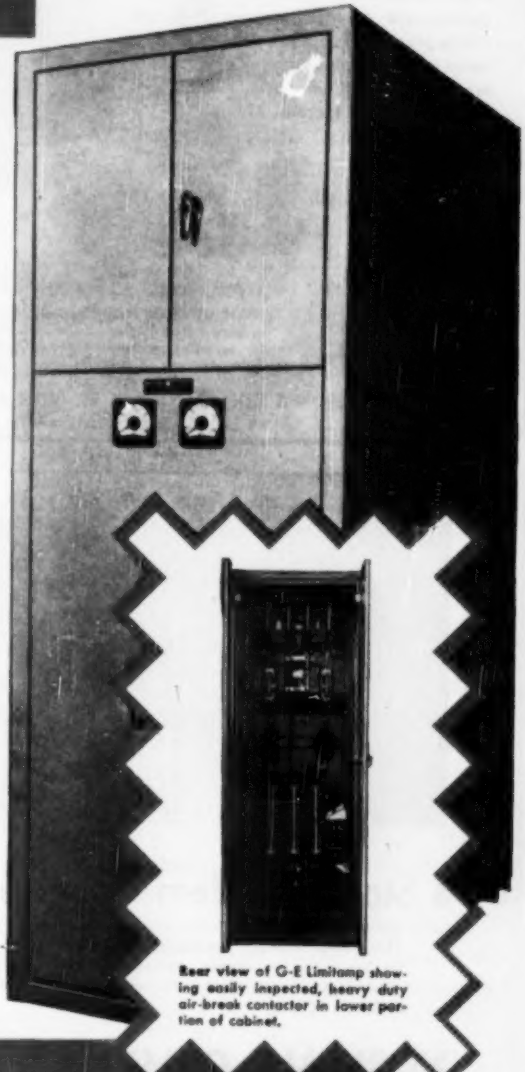
Harry Kline. Vice president in charge

(Continued)

NOW! FOR THE FIRST TIME

for motors up to 2250 hp*

LIMITAMP HIGH-VOLTAGE CONTROL



Rear view of G-E Limitamp showing easily inspected, heavy duty air-break contactor in lower portion of cabinet.

This G-E Limitamp motor controller with a new 400-amp air-break contactor is pre-engineered, factory assembled and tested—with all the control and motor protection you need in one steel enclosure.

Current-limiting EJ-2 fuses provide short-circuit capacity up to 250,000 kva. Air-break contactors are good for millions of operations with only routine maintenance, so Limitamp control is recommended especially for motors on severe duty cycles. Low first cost (only $5830** for 2250-hp synchronous motor control) as well as continuing savings because of low operating and servicing costs, make this an economical buy.

Available for 2300-volt motors up to 1250 hp, and 4800-volt motors up to 2250 hp. Ask your nearest G-E sales engineer for more information on the new 400-amp size, or write for Bulletin GEA-5409 for details on G-E Limitamp control. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

*2500 hp for 1.0 pf synchronous motors.

***List price. Subject to change without notice.*

GENERAL ELECTRIC

NAMES IN THE NEWS, *cont.* . .

of Reichhold Chemicals' phenolic plastics division. To continue as division manager and technical director.

H. E. Einert. New president and general manager of Cyrus Wm. Rice & Co., Inc., Pittsburgh, a firm of consulting water chemists and engineers.

Charles M. Holmes. Manager of Quaker Oats Co.'s chemical plant going up in Omaha; has been assistant manager of the firm's Memphis chemical plant. Started with Quaker in 1925, made Memphis plant superintendent in 1943.

Gilbert Thiessen. From technical advisor for Koppers' chemical division to manager of the central research laboratory in Pittsburgh. To supervise all laboratory research. Studied at University of Pittsburgh, University of Sheffield in England, Pitt (Ph.D., 1930). Prior positions with Koppers: technical bibliographer, manager of Tar & Chemical Division's development section, technical advisor.

Paul Harteck. To become visiting research professor of physical chemistry at Rensselaer for at least 18 months. Rector of the University of Hamburg, directed wartime production of heavy water in Germany and Norway, recently isolated quantities of tritium. Worked with Lord Rutherford in England, became director of the Institute for Physical Chemistry at Hamburg when 31 years old. Known for work in photochemistry, kinetics of gas reactions, hydrogen isotopes, low-temperature research.

OBITUARIES

Wallace T. Holliday, 66, chairman of Standard Oil Co. of Ohio's board of directors, died in Cleveland, November 7. He had been company president from 1928 to 1949.

William A. Sherman, 82, president of the South Texas Cotton Oil Co. died in Houston, November 8.

Garland Lufkin, 54, long a vice president of Owens-Illinois Glass Co. and onetime manager of the company's glass container division, died in Toledo November 23.

Henry W. Hess, 73, consulting engineer to the glass industry, died in Toledo November 29.

INDUSTRIAL NOTES

NEW LINES

Diamond Alkali Co., Cleveland–Chromic acid. The company has bought the business from E. I. du Pont de Nemours and Co., Wilmington. Du Pont will continue to manufacture the product at its Philadelphia plant but Diamond will take over distribution next month.

H. K. Porter Co., Pittsburgh, Pa.–Electric furnace steel and steel products through the acquisition of Connors Steel Co., Birmingham, Ala.

American-Marietta Co., Chicago–Admixtures for concrete, metallic aggregates for hardening concrete floors and protective coatings for concrete. They are all products of Master Builders Co., Cleveland, now an American-Marietta subsidiary.

B. F. Goodrich Chemical Co., Cleveland–Organic color pigments and dyes. Harmon Color Works, Inc., with two plants at Kearny and Haledon, N. J., is now a Goodrich subsidiary.

Olin Industries, Inc.–Polyethylene film through the purchase of a substantial interest in the Harwid Co., Cambridge, Mass.

NEW NAMES

Powdered Material Research Laboratories has changed its name to Lukens Laboratories. The laboratories have recently moved from Cambridge, Mass., to 227 California St., Newton.

Wall Chemicals Corp., Ltd., Montreal, Que., has changed its name to Imperial Oxygen Ltd. The company will continue to operate as a Canadian division of Liquid Carbonic Corp.

NEW FACILITIES

Atlantic Refining Co., Philadelphia–Additional manufacturing equipment for synthetic detergents in both its Philadelphia and Port Arthur, Tex., refineries. Estimated cost is between $3 and $4 million.

Allis-Chalmers Mfg. Co., Milwaukee–An Augusta, Me., branch office headed by D. P. Appleton.

Fisher Scientific Co.–A service plant in Washington, D. C., to speed deliveries of its laboratory equipment to the southern Atlantic states.

American Cyanamid Co., Calco Chemical Division, Bound Brook, N. J.–Additional facilities for the production of anthraquinone. They are scheduled to be completed early next spring.

Johnson Plastic Corp.–A plant in Chagrin Falls, Ohio, which will more than double its capacity for production of plastic pipe and extruded plastic industrial products. The company will continue to operate its present plant which is also in Chagrin Falls.

International Minerals & Chemical Corp., Chicago–A pharmaceutical department for its amino products division. Manager is James H. Cupps.

Gamma Chemical Corp., New York–A plant at Great Meadows, N. J., to increase its capacity for production of oxyquinoline compounds and other fine organic chemicals.

Barry Corp., Cambridge, Mass.–A plant in Watertown, Mass., for production of shock mountings and vibration isolators. Operations are due to begin in January.

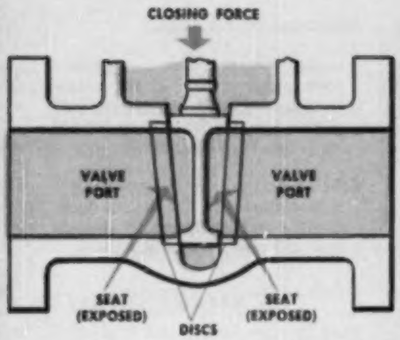
Glidden Co., Cleveland–An expanded naval stores division in Jacksonville, Fla. designed to increase production capacity by 30 to 50 percent. Also additional office and warehouse space has been purchased in Cleveland for the paint and varnish division.

Sterling Electric Motors, Inc., Los Angeles–A branch plant in Van Wert, Ohio, to serve the Midwest and East. Plans and specifications are in preparation.

Pennsylvania Salt Mfg. Co., Philadelphia–Sales office in Berkeley, Calif. R. A. Snyder will do technical sales service work for metal and maintenance, J. C. Siddall for agriculture.

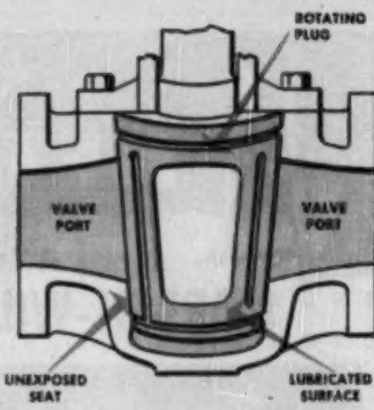
Atlantic Research Corp., Alexandria, Va.—An electromechanical division to undertake studies in ultrasonics,

(Continued)



UNLUBRICATED GATE

LUBRICATED NORDSTROM



There's no substitute for lubrication in valves...

There are only two ways to get a seal between two metal surfaces within a valve:

1. Force the seating surfaces together by distortion, which often involves excessive stresses and galling.

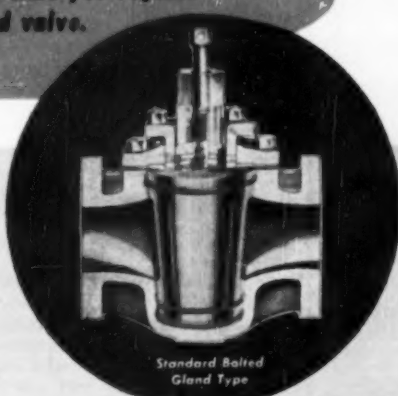
2. Use a plastic sealing medium between the surfaces.

Leakage and cutting is certain to occur where valve seats are exposed because line fluid carries abrasive elements that wear down the surface or eventually cut it.

But by using a plastic lubricant seal on the *unexposed* tapered seat of the Nordstrom valve, abrasion is avoided.

So when you install Nordstroms you stop abrasion. You then have valves that will last years longer; remain free from leakage; and turn easily. Never is it necessary to hammer-blow a Nordstrom. Lubricant hydraulically applied keeps the valve in perfect functional condition.

Switch to Nordstrom every time you replace an old valve.



Standard Bolted Gland Type

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Trade Mark Hypermatic Pats. Applied For

ROCKWELL MANUFACTURING COMPANY

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Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N.Y.

sonar vibration and explosion phenomena as well as the manufacture of related instruments and gages. The division will be headed by James W. Fitzgerald.

Reheis Co., Berkeley Heights, N. J.—A laboratory unit devoted to development and utilization of alumina gels and new aluminum salts.

NEW REPRESENTATIVES

Cleveland Crane & Engineering Co., Wickliffe, Ohio has appointed the following representatives for its Cleveland Tramrail Division: Material Handling Equipment Co., New York; John W. and W. H. Carlson, Atlanta; Cleveland Tramrail California Co., Los Angeles.

D. J. Murray Mfg. Co., Wausau, Wis., has appointed Acme Engineers, Houston to handle sales of unit heaters in Texas. American Equipment Co., New Orleans, has been appointed representative for Louisiana and Mississippi.

Insul-Mastic Corp. of America, Pittsburgh, has appointed the following representatives: Insulation Engineers, Inc., Mobile, Ala.; Industrial Roofing & Sheet Metal Co., Cleveland; R. F. Zimmerman & Co., Shreveport, La.

Magic Valley Processing Co. has appointed Morningstar, Nicol, Inc., New York, as exclusive sales agent for its potato starch.

American Flexible Coupling Co., Erie, Pa., has appointed the C. Arthur Weaver Co., Richmond, as sales representatives for all of Virginia except Arlington.

Edward Valve, Inc., East Chicago, Ind., has appointed Societe Audco Belge S. A., Brussels, Belgium, as sales representative in continental Europe.

Elgin Softener Corp. has appointed F. H. Dunk Associates to handle its line of water conditioning equipment and water treating chemicals in the Cleveland area.

NEW LOCATIONS

R. B. MacMullin Associates, consulting chemical engineers, has moved to 610 Niagara Bldg., Niagara Falls, N. Y. An enlarged staff now includes R. B. MacMullin, director;

D. W. Hengerer, pulp and paper activities; P. B. Beno and R. A. Williamson, process engineers.

Steiner Plastics Mfg. Co., formers and fabricators of thermoplastic sheets, rods and tubes, has moved to a new plant at Pratt Oval, Glen Cove, N. Y.

Sumner Chemical Co. has moved its sales office to 6 East 45th St., N. Y.

E. F. Houghton & Co., Philadelphia, manufacturers of industrial oils, leathers and metal-working products, has moved its sales office to 55 West 42nd St., New York.

Roger Williams, Inc., engineers, economists and public relations consultants to the chemical industry, has moved to 148 East 38th St., New York.

Mears-Kane-Ofeldt, Inc., manufacturers of automatic gas-fired steam boilers, has moved to its newly completed factory and offices at Church Rd., Montgomery County, Pa.

Sharp & Dohme, Inc., Philadelphia, has moved its New Orleans branch office to 939 Southern Jefferson Davis Pkwy.

Puritan Compressed Gas Corp., manufacturer and distributor of chemically pure gases for anesthetic and therapeutic purposes, has moved into a new and larger plant at 1125 Levee St., Dallas, Tex.

Kano Laboratories will move to Nashville, Tenn., as soon as its plant at 1000 South Thompson Lane is completed.

Philip J. Lo Bue Co., manufacturer and distributor of industrial chemicals, has moved to 277 Park Ave., New York.

Nuclear Development Associates has moved to 80 Grand St., White Plains, N. Y.

Pennsylvania Salt Mfg. Co. has moved its Chicago district sales office to 228 North LaSalle St.

Pennsylvania Salt Mfg. Co., Philadelphia, is in the act of moving all production at its Easton plant to its plant at Cornwells Heights, Pa. Transferred to the new location will be production facilities for laundry and dry cleaning products, emulsion type metal cleaning compounds. —*End*


"This Texas territory was well worth fighting for," says General Sam Houston
And General Sam would agree that these Texans have fulfilled his dreams in the last half century by developing the Southwest into the largest industrial area in the United States. This territory with its vast natural resources, assured low-cost power, temperate climate, and central location for low-cost distribution offers industry the geographical area ideal.
Brown & Root offers you experienced counsel, backed by more than thirty years of successful engineering and construction in this great Southwest. Its complete knowledge of soil, terrain, people and climatic conditions will result in faster, more economical completion of your contemplated project. A request from you will put Brown & Root consultants at your service.
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Quotes, Extracts and Digests

MORGAN M. HOOVER, Assistant Editor

Three Characteristics Common to Successful Managers

Chaplin Tyler

Are you of executive caliber? My own approach to this question is unorthodox. What I did was to list the names of executives with whom I have worked closely at various times over a period of 30 years. In the list were educators and editors as well as line executives and staff executives in industry. Included were young men on their way up as well as old timers. From this list I selected those that seemed outstanding in capability, that is, as capable, taken as a group, as one might find anywhere. I then posed for myself this question: *What broad characteristic do these executives have in common?* The broad characteristics as I view them are three in number:

1. *Energy or Drive*—This characteristic is manifest by great capacity for work, coupled with constructive direction of personal effort. One is impressed that such drive is directed at achieving results for the organization rather than primarily for self. Furthermore, this manifestation of energy is infective; it tends to impel or motivate effort in others.

The capable executive is a determined person. He has a sense of direction, a plan, and a timetable. He is not only a good starter but is also an equally good finisher.

A tendency toward laziness is so widespread among human beings that it probably should be considered normal. But in this respect it seems to me that the outstanding executive is not normal—he is abnormal. For example, not one of ten persons that I would rate as top-grade executives seems to be happy unless engaged in some demanding situation. On the other hand, many that I would rate as mediocre do not push themselves.

The hope of monetary rewards or of broadened power may not be the primary incentive motivating the top-grade executive. The ten individuals referred to previously seem to be motivated by something else. Their philosophy of life is to give the job all they have. Material rewards and bettered position then follow as a matter of course.

Chaplin Tyler is an executive of the Development Department, E. I. du Pont de Nemours & Co.

2. *Effective Intelligence*—Because the executive spends so much time working with people, there is a tendency to overlook his role as a thinker. Actually the proper sequence in executive effort is thought followed by action. In spite of the staff assistance which an executive must have, a point is reached in every situation where the executive finds himself alone, figuratively speaking. He must "think the problem through" which means (a) defining the problem, (b) resolving it, and (c) deciding on a practical course of action.

The person of effective intelligence possesses more than intellect. Usually he has an inquiring mind, continually seeks better ways and means of doing things, and has ability to express ideas clearly and fluently. He is intellectually honest, and he thinks straight. Although decisiveness is a mark of the good executive, one may be decisive and yet be a poor executive. Sound decisions are based on sound reasoning, i.e., the result of practical application of one's mental ability.

In solving problems, the top-grade executive is particularly wary of high-spot or superficial investigation. Thoroughness is the watchword, even at the expense of much valuable time. As one executive said to me, "Given sufficient data, a problem tends to solve itself; my mind must be saturated with facts before the right answer becomes apparent."

Many, if not most executive problems are of a recurrent type, though differing in their particulars. The good executive therefore tries to rationalize much of his thinking by developing formulas, even though these formulas may not be wholly quantitative. Examples of such problems are found in the fields of plant location, investment, choice of research projects, market surveys, and pricing.

3. *Effective Relationships with People*—From the executive viewpoint, people fall into three groups—superiors, associates, and subordinates. But far from being conscious of rank, the man of executive caliber strives to have equally good working relationships with all three groups. With respect to superiors he takes orders and accepts constructive criticism without resentment; with respect to associates he is unstintingly collaborative; with respect to subordinates he strives to evoke cooperative effort rather than to impose authority. This last factor is sometimes called leadership ability.

In making important assignments and in major realignments of organization, the top-grade executive is eager to give whatever help he can in getting the work started in the right direction. We hear a great deal about the importance of initiative, but lack of initiative probably is not as serious as lack of coordination. The good executive, according to my observation, is a good coordinator. Having lessened the likelihood of confusion, he knows the individual initiative can have ample play without causing undue friction. Conversely, I once knew an executive who seemed to take sadistic delight in setting one subordinate against another. According to him that was the way to develop strong men; i.e., only the fittest survived. Ironically, it didn't work out that way. Not only did some strong men rebel and resign, but the executive himself finally was fired.

In five of ten cases taken at random, my observation leads me to conclude that the primary cause of failure was ineffective relationships with people. In three cases, lack of drive was primarily responsible. In the remaining

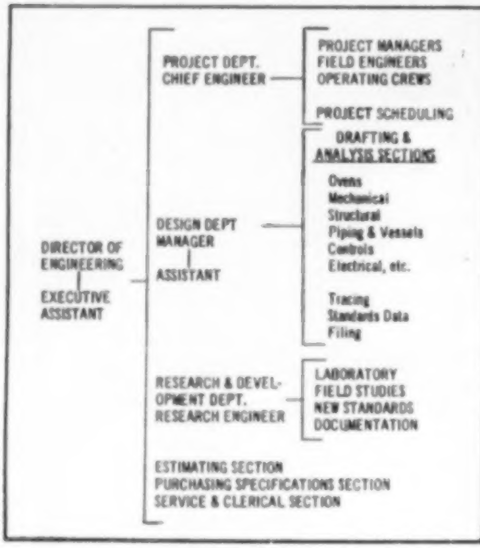
(Continued)

two cases there was primarily a lack of effective intelligence. In no case was failure due to all-around deficiency, and in no case was there any evidence of deterioration, i.e., none of the individuals concerned had undergone any notable change in character.

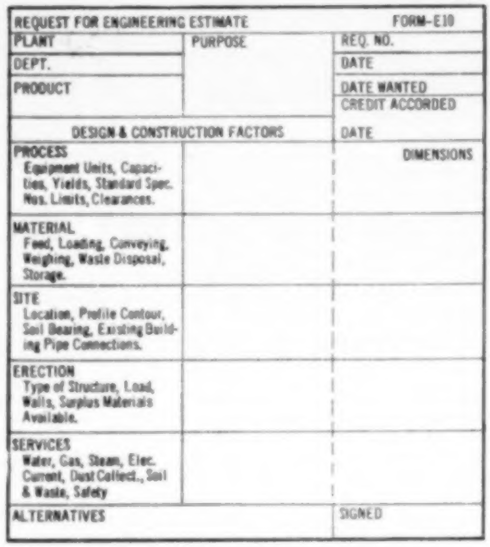
In retrospect, one might ask why these individuals were advanced in the first place. Apparently there was lack of appreciation by those responsible for the promotions of the importance of balance as a factor in executive success. There is undoubtedly a tendency to overlook or even forgive a deficiency with respect to one characteristic when the other two are present in high degree. The hope, or reasoning seems to be that the strong characteristics will compensate for the deficiency. Experience indicates that the risk involved is great.

Suppose we again face the question, "Are You of Executive Caliber?" Clues to the answer probably lie in your own experience: For example, do people look to you to get things done? Are you in demand to head committees? Or do you like to sit tight and let the other fellow carry the ball? Are you called upon frequently to analyze tough problems, or are you merely asked to contribute data? Have you contributed in some substantial way to the advancement of your business, such as for example the formulation of better policies, rationalization of operations, or ideas that have matured into new or improved products? Do you enjoy working with people, or are you happier when left alone with a problem? Do you jump (almost literally) at the chance to give an associate a lift, and do others jump at the chance to give you a lift? In brief, do you have the will to do; do you think straight; and do your actions evoke cooperative efforts?

Chaplin Tyler, E. I. du Pont de Nemours and Co., before the Management Symposium, American Institute of Chemical Engineers, Minneapolis, Sept. 11, 1950.



Lines of responsibility of a staff set up for the design and construction of coke ovens and byproduct plants.



REQUEST FOR ENGINEERING ESTIMATE		FORM-E10
PLANT	PURPOSE	REQ. NO.
DEPT.		DATE
PRODUCT		DATE WANTED
		CREDIT ACCORDED
DESIGN & CONSTRUCTION FACTORS		DATE
PROCESS Equipment Units, Capacities, Yields, Standard Spec. Nos. Limits, Clearances.		DIMENSIONS
MATERIAL Feed, Loading, Conveying, Weighing, Waste Disposal, Storage.		
SITE Location, Profile Contour, Soil Bearing, Existing Building Pipe Connections.		
ERECTION Type of Structure, Load, Walls, Surplus Materials Available.		
SERVICES Water, Gas, Steam, Elec. Current, Dust Collect., Soil & Waste, Safety		
ALTERNATIVES		SIGNED

Object of this form is to save time by getting the customer to set his requirements down completely at the outset.

Design Engineering Goes to Modern Production Methods

Lewis Clayton

Design engineering has become an increasingly important and complex function of heavy industry, as mechanization has grown, and has undergone corresponding changes in its methods of organization.

A single unit of present day petroleum process equipment, for example, may involve as much work as the building of a complete refinery 15 or 20 years ago. In the chemical industries, there has been the introduction of automatic controls and continuous processes, easier to operate but more difficult to design. In most industries, in Europe as well as in the United States, the advances made in process engineering have combined with economic factors to augment the demand for complete plants conceived and built as an assembly of standard components.

For some drafting offices this trend has taken concrete expression in the fact that the general-arrangement or layout draftsman has found himself with much more to do, while the section detailers have had relatively less load. Within limits, there is less detailing and more reference to catalogs, technical data sheets, standard specifications and standard drawings—which places a heavier burden on those sections of the organization charged with standardizing, codifying, filing and maintaining these reference materials. Technical data analysts have an important role as physical and chemical data on materials treated in the processes subject to design are correlated, computed and plotted in a graph form for the permanent use of the mechanical designer.

Finally, the pressure of time is ever

(Continued)

Puzzle for experts

There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

Grinnell integrates the many factors in this complex, highly technical assignment in one organization of specialists. Major economies result from this single responsibility which includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

You'll find it to your own best interests to draw upon Grinnell's century-long, specialized experience in power, process and industrial piping.

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QED, cont. . .

increasing. By today's rules of investment and obsolescence, a new plant is expected to be designed and built in about half the time that it was considered normal in former years. Design engineering is managed as a production department, producing drawings and specifications—in the sequence, in the volume and at the calendar dates determined by an exacting project schedule.

Organization of a modern design department to meet these requirements is outlined in the accompanying chart, showing the lines of responsibility of a staff engaged in the design and construction of coke ovens and byproduct plants, representative of a broad field of heavy engineering enterprises. Some of these typical functions are briefly reviewed here.

PROJECT ESTIMATES

In many design departments, one of the most time-consuming elements of the work is to determine exactly what is to be designed. Repeated exchanges of partial information between customer and design department are a familiar occurrence and various means have been developed to improve this preliminary fact finding. In a large chemical company with a number of factories, the individual plan manager initiates any project by making out a Request for Engineering form of the type illustrated. In each case the object is to save time by getting the customer or ultimate operator to set down at the outset his requirements as clearly and completely as he can.

PROJECT SCHEDULING

Closely related to the design function are the duties of procurement, expediting and inspection. In a contracting organization these latter responsibilities are formal. In other cases, there is a tendency at least for the engineering department to follow up or watch over the execution of its plans. The drawings themselves are often produced, not in a logical design order, but in a sequence dictated by the time of procurement of each component. From this point the execution of the undertaking is largely a matter of foreseeing obstacles to on-time completion and taking action soon enough to overcome them.

Over-all schedules are summarized for the project manager on a progress chart, in which progress is measured against the calendar rather than in terms of manhours or percentages completed. In a plan of this kind, dates and duration of each step are fixed in agreement with the person taking the responsibility for that step. This encourages initiative, promotes clarity in the transmission of data and helps the executive to take prompt remedial action.

Cash expenditures are followed on a similar chart, comparing actual outlay or commitments with the budget for each phase of the contract.

DESIGN OFFICE SCHEDULING

It was once assumed that a design drafting department was not suited to time scheduling, but experience has demonstrated that a simple method of daily planning enables a department to turn out 25 percent more finished drawings.

When each new job is assigned to a layout man, detailer or tracer, an estimate of duration is made by the section chief or planner, time is reserved on a pencil chart and actual progress is posted daily against this schedule. Giving a man a week's work at a time is not, in general, making a plan in this sense. When a piece of work will occupy a man for a week or more, comprising the production of a number of sheets, it is necessary to consider in advance the steps to be taken to design the given subassembly, to estimate how many finished sheets there will ultimately be and to give out the work a sheet at a time. The purpose of the planning chart is not to push the men, but to make the most advantageous distribution of work ahead, eliminating waste time, and to bring attention at once to the points where the work is going more slowly than foreseen.

Use is often made of small time cards which can be sorted by plan number or by type of work and on which the draftsman accumulates actual hours against the original time allowance. Such analysis of all of the elements required to complete the drawing usually results in a file of fundamental elements that are largely repetitive, in spite of variations in sizes or contours, and on which reasonable time allowances, and even incentive payments can be based.

NEW STANDARDS

In addition to the various national standards, each drafting department has its own standards, based on past practice and on the premise that a large part of any new contract is not unique and may be designed as a variation of a past undertaking. However one of the management objectives that is being most successfully met in the modern reorganization of design departments is to loosen the hold of tradition and induce more looking ahead.

In process plant construction, heavy concrete insulation is giving way to new lightweight fireproofing. In coke-oven design it was standard practice for 70 years to have the oven top one meter thick until a modern designer found a reason to set up a new standard. Coal washeries, metallurgical plants and refineries offer similar examples in which structural design has been very slow to match the progress made in process engineering.

The task of looking beyond the present practice and systematically developing better standards and design policies is accordingly recognized as a function of the engineering department. This mission may be given to the mechanical development division, or to a research section, but its fulfillment depends on the degree of understanding throughout the department, and this in turn depends to a considerable extent on carefully planned and maintained methods of management.

From a recent paper by Lewis Clayton, Chief Engineer, Office of Graham W. Parker, Industrial Consultants.

OLD PRINCIPLE

. . . *New Application*

Francis H. Snyder and C. J. Plisky

Take a sheet of paper, hold one end and try to balance a fountain pen on the other. Can't be done. But roll the same sheet into a tube, insert the pen in the tube and the paper supports it easily.

That's the principle of a radical departure from traditional freight car construction engineered by the Pressed Steel Car Co. Its name, Unicel; its future, optimistic. (For a discussion of advantages, see p. 208.

Here's what's new and different about Unicel.

The ordinary freight car has a center sill of steel, like the keel of a ship. This sill is the essence of the car: it supports the load, absorbs stresses, strains and shocks, the framework is built upon it. Walls and roof serve no purpose other than protection. Because of its nature, the sill as well as the rest of the car, must be heavy and cumbersome. Concentrated forces up to 50,000 psi. must be compensated for.

The new car makes use of the principle of the hollow tube as above. The whole car absorbs stresses, strains and shocks. The greatest stress on any one part is 3,000 psi. Thus the car is lighter, stronger and even bigger.

The construction features are essentially these: the inside of the car is a

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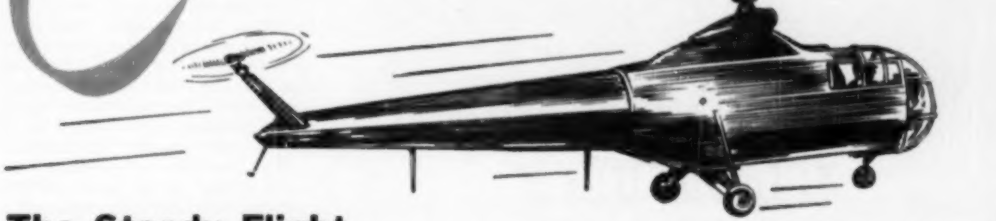
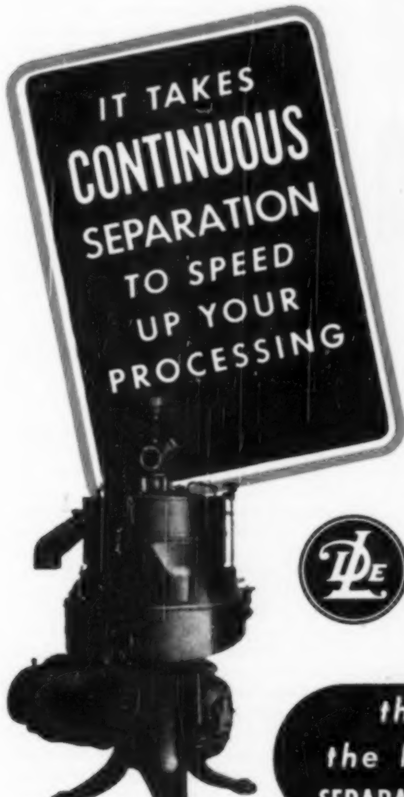
IT'S GOT TO BE *Continuous!*



The Steady Flight of the Helicopter



So must processing be continuous to be truly economical and fast. De Laval centrifugal machines make separation or clarification as continuous as any other phase of your process. They do in minutes or even in seconds work that once took hours by settling or other slow means.

Problems of separation or clarification are not all alike. Many factors—specific gravity and viscosity of the liquids, the quantity of solids present in one or both liquids, the kind of solids—influence the choice of the type of centrifugal machine. De Laval has a complete line of machines, each designed to do a particular job to best advantage. You can be sure with De Laval equipment that separation or clarification is most complete.

Your problem may be quite similar to one that has already been solved by De Laval machines. It will pay you to ask.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

IT'S *DeLaval* FOR

the First Name in Centrifugals
the First Thought for CONTINUOUS
SEPARATION · CLARIFICATION · CONCENTRATION

closed tube of continuous laminated plywood. Similarly an outside wall encloses the inner one. The two shells of plywood are joined by vertical and horizontal cross members between—the box-girder-continuous-arch principle. The continuous plywood becomes a tight skin able to withstand enormous loads because it distributes stresses uniformly throughout the entire structure. It's called "monocoque" and the idea comes from aeronautical engineers.

The plywood sheets are bonded and shaped in one operation. That's because the special phenolic resins developed by Snyder Chemical Corp. are able to set up under heat while being held between electrodes in a hydraulic press. Pressure ranges from 150 to 200 psi. at temperatures of 200 deg. F.

The plastic for the outside of the car is applied in the same bonding operation. The masking stock and a resin-impregnated paper, colored and stenciled, are also part of the bonding technique. Net result is that the hull is shaped, fitted, protected and decorated in one operation. The adhesives and coatings, both members of Snyder Chemical's Synco series, are resistant to weathering, fungi, chemicals and can even be steam sterilized.

Besides being cheaper and easier to build the manufacturer predicts longer life, less maintenance for the car. To the shipper, it means bigger payloads at less cost along with a number of other advantages.

Francis H. Snyder, Snyder Chemical Corp., and Clarence J. Pilsky, Pressed Steel Car Co., before the Forest Products Research Society, Memphis, Oct. 25, 1950.

PROCESS INDUSTRIES

. . . *Looking Ahead*

Wallace F. Traendly

Since June, most of the chemical process industries have been pushing capacities to keep up with demand. Plans for capital expansion in this fastest growing segment of U.S. industry have enlarged tremendously. Most recent estimates indicate a capital spending rate for 1950 of $2.8 billion, a full third of that of all manufacturing. And this growth is expected to continue—at an annual rate of $3 billion or better from 1951 throughout the next decade.

Current consumption of industrial chemicals in the process industries is more than 10 percent ahead of previous record levels. Today chemical process plants are turning out products at a $40 billion annual rate. Of course Korea has been a major influence in

this boost. But, even before the Red Invasion, the process group was setting new records and conservative forecasters had predicted a 70 percent increase in value of output by 1960 as compared with 30 percent for all manufacturing as a whole.

Synthetic fibers like rayon, nylon and the newer Orlon and Fiber V have been growing at a rate which may double their production by 1960. At present, chemical plants are furnishing about 20 percent of our fiber requirements. Within 10 years, at the current rate of growth, close to 40 percent of the fiber consumed in U.S. textile mills is likely to be synthetic. Defense demands for specially woven lightweight uniforms, opening up a vast new market for these fibers, will hasten this development. On the consumer end, synthetic fiber firms predict that men's year-round clothing will soon be on the scene.

Plastic materials are finding wider applications every day. Molding materials continue to replace metal and wood. Plastic sheeting, coatings and adhesives will all come into greater use. Petrochemicals have glamorized the petroleum business. A swelling stream of chemicals will come from refineries as the oil firms go further into this field. By 1960 about 40 percent of all synthetic organic chemicals will be made from oil and natural gas and production of other refinery products is expected to rise sharply.

Another prospect in the line-up of new process industries is the coming birth of a full-scale coal distillation and hydrogenation program. Medicinals too, will be used in even larger quantities. Antibiotics have obtained the biggest headlines—however, other medicinal chemicals are also growing in stature. New products and new uses are appearing regularly under the stimulus of industrial research.

Chemicals for the farm have offset the higher cost of farm labor and the gradual depletion of the soil. Demand for fertilizers and insecticides plus new livestock vitamins and drugs to stimulate the growth and reduce disease indicates total consumption of agricultural chemicals will be up more than a third by 1960.

Wallace F. Traendly, publisher, *Chemical Engineering* and *Chemical Industries*, before New York Chapter, Industrial Advertisers Association, Oct. 9, 1950.

PENTACHLOROPHENOL

. . . Green Pine Preservative

E. A. Behr and R. T. Rogers

In order to determine if pentachlorophenol-petroleum oil solutions could be impregnated into very green south-

(Continued)

POINT . . .

"By 1953 the U. S. will need 125 million tons of steel, but its capacity will be only 100 million tons."

GIRARD DAVIDSON
Assistant Secretary of the Interior

QED, cont. . .

ern yellow pine poles and give good distribution and retention of preservative, a testing program was set up.

Six freshly cut southern yellow pine poles were sawed in two. One half of each was treated shortly after cutting with coal-tar creosote and the other half was treated with pentachlorophenol-petroleum oil solution. The oil used was similar to a No. 2 fuel oil but slightly more aromatic. Five percent pentachlorophenol by weight was added to the petroleum oil to make up the preservative solution. Poles were cut in three sections after treatment and penetration on the cross section examined. Amount of water removal was measured as well as amount of preservative in different sections of the wood extending inward from the center. Results showed that penetration and distribution of pentachlorophenol-petroleum oil solutions in green southern yellow pine which had been steamed before pressure treatment by the Rueping process were as good as, if not better than, comparable coal-tar creosote treatments. The length of steaming and vacuum time required to condition green southern yellow pine poles for treatment with the pentachlorophenol preservative was appreciably less than standard commercial practice. The time required for maximum injection of preservative into these poles was less for the pentachlorophenol preservative than for coal-tar creosote.

In view of these results it appears that pressure treating schedules should be re-examined for possible savings in time, since high moisture content wood is almost always considered to be less easily penetrated than seasoned wood.

E. A. Behr and R. T. Rogers, Chapman Chemical Co., before the Forest Products Research Soc., Memphis, Oct. 25, 1950.

SAND-RESIN PROCESS

. . . For Foundry Molds

Both foundry men and makers of phenolic resins are working to bring a new resin-sand process for making foundry molds and cores to full-scale production, where it might well become the biggest single market for the

. . . COUNTERPOINT

"No one has yet invented an accordion-pleated steel plant (or any other plant) that will contract conveniently under the glowering eye of the Department of Justice and then expand obligingly in times of national peril."

Benjamin F. Fairless
President
U. S. Steel

resins. The automotive industry, as one of the chief users of small cast-metal parts, has invested more than \$2 million to investigate the process, and some pilot-line installations are now operating. Developed in Germany, and brought here after the war, the new process promises real savings and improvements.

In the usual process, a wooden pattern corresponding to half the shape of the object is placed in a box, and a large quantity of damp sand is packed around it with two funnel-like holes. The pattern is removed, molten metal is poured in one hole, and the gases and any excess metal bubble up through the other hole. After the metal hardens, the sand is shaken loose to be used again. Special techniques are required for products with hollow centers.

Although there are many modifications of the new process, a typical example uses a mixture of 100 parts dry sand and 8 parts of a thermosetting phenolic resin binder. A metal pattern is treated with a silicone resin, much in the manner of greasing a cake pan, and is then heated; the resin-sand mixture is dumped on the hot pattern, where it builds up to a thickness of $\frac{1}{4}$ to 1 in. The excess resin-sand mixture is shaken off and used again. The pattern covered with a thin layer of the resin-sand mixture about $\frac{3}{16}$ in. thick is heated in an oven for 1 to 4 min. until the resin is set, forming a thin shell over the pattern; the shell or half-mold is then removed from the pattern. Cores to fill hollow spaces in the final product are made by blowing the resin-sand mixture with compressed air into a split heated metal core box. Two of the half-molds, together with cores, if required, are assembled to make the completed mold. This is embedded in a box of steel shot, where it can receive the molten metal. The shot supports the shell and serves to control the heat of the molten metal; the resin-sand shell is sufficiently porous to allow escape of the gases, and no special vent is needed. This means an important saving in later finishing and machining costs as well as savings in metal. The mold surfaces are so smooth that the resulting casting has excellent surface quali-

(Continued)

QED, cont. . .

ties, and requires little or no surface cleaning. Although each mold is good for only one casting, the metal patterns and the steel shot can be used indefinitely.

It is claimed that sections as thin as 0.01 in. can be poured and, with care, tolerances of 0.002 to 0.003 in. for small castings can be achieved, thus lowering machining costs and saving metal. The method has been used successfully for castings up to 100 lb., and it is expected to be most useful for mass production of identical and relatively small castings for automobiles, tractors, and farm machinery. Such items as door handles and exhaust valves are commonly cast, and savings in this operation could be substantial.

The volume of sand necessary for making molds can be reduced by 90 percent; machining and cleaning costs are claimed to be cut by as much as 80 percent; improved working conditions result from the relative freedom from excessive dust and heat; more efficient handling of materials and better use of foundry floor space are also claimed. Hardened molds can be made ahead of time and stored until needed.

—From the October 1950 issue of A. D. Little's Industrial Bulletin.

INDUSTRIAL PREPAREDNESS

. . . For Atomic Attack

S. Charles Rothmann

What are industrialists doing now to prepare for atomic attack? Make no bones about it, the danger is clear and present. And it's appalling to note how few are the number of plants adequately prepared. If you do not have a plan on paper or in your mind, the following steps might be suggested.

1. Set up a planning organization the size and composition of which will depend upon your plant size, location, products manufactured, etc.

2. After you have set up your planning organization proceed with a logical indoctrination program starting with top management, then on down the line until every employee is reached eventually. (A list of appropriate publications, films, etc., may be drawn up.)

3. Make an over-all survey of your plant hazard problems from the stand-

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UNO: SOS

"The war of the future is going to teach us a new set of ABC's—Atoms, Bugs, and Chemicals!"

Sidney D. Kirkpatrick
Editorial Director
Chemical Engineering

WHAT?

"There is need of much closer contact between industry and our schools . . . 61 percent of one group of high school seniors (in Connecticut) thought they favored closer governmental regulation of business as against free competition."

Robert E. Wilson
Chairman of the Board
Standard Oil Co.

point of fire, toxic and corrosive materials handled.

4. Simultaneously with this survey, an inventory might be taken on all protective, preventive or precautionary equipment you have on hand or might need.

5. Review and bring up to date all the rules or regulations pertaining to the prevention of loss of life, limb or property.

6. Divide your plant into evacuation areas:

(a) Evaluate and designate buildings which might be adapted or converted into shelters.

(b) Check on the availability and adequacy of the facilities you might have on hand for fire prevention and fighting, first aid, demolition, etc.

7. Enlist the cooperation of your neighbor plants, civil defense organizations, municipal officials, etc. Find out what they have available and are doing. Let them know what you have available and are doing.

S. Charles Rothmann, American Cyanamid Co., before the Elizabeth Chamber of Commerce meeting, Elizabeth, N. J., Oct. 23, 1950.

SYNTHETIC FABRIC BLENDS

. . . *In the Works*

J. B. Quig

New fabric blends superior to any textile now available are on the way. By blending the truly synthetic fibers with each other and also with the rayons, cotton, and wool, it will be possible to produce many new fabrics possessing a combination of properties which are superior to those hitherto obtainable.

Nylon has contributed so markedly to the variety of textile properties available that it may safely be claimed to have started a revolution. It would be impossible, however, for one fiber to have all the properties which are desired for all uses. Fiber V and Orlon possess properties which will complement those of nylon, and this trio should complete the revolution which has barely started. That their respec-

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tive uses will overlap is obvious but it seems equally apparent that each can and will serve purposes which the other cannot do as well.

It appears that truly phenomenal wear life can be obtained with nylon; outstanding resilience can be offered by Fiber V; while topnotch weathering, extremely light weight and moderate resilience are characteristic of Orlon.

These three synthetic fibers as a class have properties not possessed by other fibers; high strength, water insensitivity (quick drying, dimensional stability, equivalent wet and dry properties), ability to be heat-set, freedom from insect and mildew damage, and —compared with natural fibers—economy in mill processing.

Nylon has outstanding abrasion resistance and general toughness. Its suppleness is destined to be important in lingerie. Its high strength and durability have been employed in heavy-duty tires to economic advantage on a value-per-unit cost basis.

Fiber V, on the other hand, inherently has a high bending modulus which permits the making of sheer, extremely lightweight fabrics (curtains, tulle, voiles, organdies) which are crisp and highly wrinkle-resistant in their natural state without resin treatment. Its high stretch resistance is unique in many sewing applications where fine strong seams are required.

Orlon fiber possesses unusual ultraviolet light and chemical resistance. These properties have been used in outdoor fabrics which greatly out-perform conventional materials in comparative life tests. After 385 days in Florida, an Orlon awning fabric lost only 15 percent tenacity while cotton lost 60 percent.

Considering the staple forms of these three fibers, nylon has invaded deeply the knitwear fields. Properties of abrasion resistance and easy maintenance have contributed to its rapid acceptance in these uses. For transportation upholstery—for automobiles, buses, trains, and airplanes—the use of this staple is certain to grow rapidly because of its demonstrated ease of maintenance and long wear life compared to other fabrics. Fiber V staple has been used in tropical worsted type suitings to produce fabrics even more resilient than 100 percent fine wool. The features of Orlon staple are its warm, wool-like feel and its extremely high bulking power. These properties are expected to be of high value in winter suitings and overcoats that are light in weight but as warm as conventional heavy wool fabrics.

It is becoming more and more evident that no individual fiber will be

LOW BRIDGE

"While this country needs a minimum of 30,000 new engineers annually, within four years the annual output from our colleges and universities will fall below 10,000."

S. C. Hollister, *Dean College of Engineering Cornell University*

universally acceptable for all textile purposes.

J. B. Quig, E. I. du Pont de Nemours & Co., before the Southern Assn. of Science and Industry, Atlanta, Oct. 17, 1950.

CHLORINE DIOXIDE

. . . *In Water Purification*

R. N. Aston

A chlorine compound sterilizes drinking water as effectively as the element itself, but without imparting an unpleasant chlorine taste.

The compound is chlorine dioxide, and it already has made an important place for itself in the water treatment industry as a means of both taste and odor control. The compound has been found to equal or surpass chlorine as a germ-killer.

Generally it is as economical as other methods for taste and odor control. In some instances where it may be greater in cost, the increase is justified by superior results esthetically and biologically.

While not immediately advocated in all cases as a bactericide, owing to economics, chlorine dioxide in many waters—due to ammonia content or other factors causing high chlorine demand—may be more economical than chlorine.

Although known as a chemical compound since 1802, the gas has been readily available for only about 10 yr. It is so unstable that it cannot be bottled or shipped, and must therefore be made at the point of use from sodium chlorite. Chlorine dioxide is widely employed for the bleaching of flour, and also for odor control in soap plants and for the treatment of industrial wastes.

More than 125 cities in the United States and Canada, including Philadelphia and Washington, now use chlorine dioxide to remove taste and odors from water supplies although the compound's bactericidal properties were first reported in 1947. A minute quantity of the substance has been shown to kill the common water pathogens, or disease-causing organisms, within 5 min. In addition, the virus of poliomyelitis is inactivated.

R. N. Aston, Mathieson Chemical Corp., before Southwide Conference, American Chemical Society, Atlanta, Oct. 17, 1950.

—*End*

Chemical Engineer's Bookshelf

LESTER B. POPE, Managing Editor

Chemicals vs. Materials of Construction

NOTE: *The name of Jim Lee has long been associated with materials of construction for the chemical process industries. His years of experience have been reflected in most of Chem. & Met.'s biennial reports on the subject. We are proud to call your attention to our associate's new book. We wanted to feature it here. But we did not want to write a review and face a possible charge of prejudice. That's why we asked one of International Nickel's corrosion authorities, Wayne Friend, to tell you about Jim's book.*—EDITOR.

MATERIALS OF CONSTRUCTION FOR CHEMICAL PROCESS INDUSTRIES. By James A. Lee. McGraw-Hill Book Co., New York. 468 pages. $6.50.

Reviewed by W. Z. Friend

James A. Lee

It is a difficult and time-consuming job for the chemical engineer, plant engineer, equipment fabricator or other persons charged with the selection of materials for construction of chemical process equipment to wade through the large mass of technical and commercial literature dealing with the corrosion resistance of the wide variety of metallic and non-metallic construction materials and to determine which ones are most suitable for handling the corrosives involved. Even when this chore is accomplished there may be some uncertainty as to the actual performance to be expected if the individuals have no previous experience in handling the particular corrosives on a plant scale, as evidenced by the significant number of corrosion failures which still occur. Frequently, the courses of study in chemical engineering curriculums as well as books and articles dealing with chemical processes give only minor attention to the performance of construction materials from the standpoint of corrosion resistance, so that a suitable background of performance is not too readily come by.

Mr. Lee, during his more than 20 year's association with the chemical and process industries, a good portion of this time as managing editor of *Chemical Engineering* and its predecessor *Chemical & Metallurgical Engineering*, has been very much aware of these problems. His many informative articles describing chemical plants or chemical processes have been of unusual interest because, in addition to discussing such essentials as the chemistry of the process, flow of materials and types of equipment involved, he always has made a special effort to provide available information as to materials used in construction of the processing equipment. In the present book he has happily extended this effort still further by assembling and correlating in one place much of the available information on construction materials used in the production and handling of more than 300 chemicals and chemical mixtures.

Emphasis throughout the book is upon materials of construction that have been used and been found by operating experience to be the most serviceable and economical in commercial-size plants. Aside from the author's own experiences, much of the information is taken from articles and reports published by engineers and other workers covering plant practice. It has been supplemented by some heretofore unpublished material. Source references are provided for those who wish to make further investigation. Where information is taken from trade literature, the author has made a generally successful effort to eliminate claims or estimates of performance based only upon the results of laboratory corrosion tests and not confirmed by plant experience. Useful information on German plant practice with construction materials was obtained from the reports of American and British teams of scientists and engineers who visited German chemical plants shortly after the war.

In its organization the book deals with each of the chemicals and chemical mixtures in alphabetical order as a sort of brief "chapter." Each chapter, where the information is available, is divided into three sections: production, handling, and packaging. In the first section a preliminary discussion of metallic and non-metallic materials used in production of the chemical is followed by a description of the process in which construction materials are indicated for each major piece of equipment where possible. Considerable use is made of flowsheets for this purpose. The second section is concerned with the corrosiveness of the chemical when it is being used as a finished product, or as a raw or intermediate material in the production of some other chemical product. The third section deals with materials used for shipping containers. There is a directory of construction materials which includes some 550 metallic and non-metallic materials, giving trade names, manufacturers and composition or brief description.

If one must find a fault with the book it would possibly lie in the need for more complete operating experience with some of the chemicals, particularly some of the less commonly used ones. This is of course not really a fault since the amount of data presented can be no greater than the amount of information which has been published or is available to the author. There can be no doubt that an effort has been made to include most of the significant information which could be located with many of the more common chemicals, this covers a surprisingly large number of construction materials. The book should provide a highly useful guide and reference work for all who are concerned with design, construction and maintenance of chemical process equipment as well

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as for engineering students. It is the most recent addition to the McGraw-Hill Chemical Engineering Series.

Predecessors Obsolesced

TREATISE ON POWDER METALLURGY. Vol. II. By Claus G. Goetzel. Interscience Publishers, New York, 910 pages. $18.

Reviewed by C. L. Mantell

Powder metallurgy as an art and science has grown tremendously in its literature in the last 15 years. Sooner or later it appears that every worker in the field desires overwhelmingly to give birth to a book which includes everything up to the date of publication. He then becomes a propagandist for all possibilities of extension of the field, without critical examination of the economic probabilities.

Goetzel's second volume is aptly named—it is a treatise omitting no contributor, even if his work added nothing but duplication. In his preface he states: "Powder metallurgy is still very much in a state of flux. It is therefore not surprising that the amount of information that has appeared in the literature—both on technical and on theoretical issues—during the last few years alone is truly tremendous. Neither is it surprising that much of this information is controversial or preliminary in character, and subject to revision in coming years."

Vol. II covers the scope of the following chapter headings: Refractory Metals and Alloys, Hard Metals and Compositions, Electrical Materials and Products, Magnetic Materials and Products, Ferrous Materials for Structural Parts, Nonferrous Materials for Structural Parts, Porous Products, Friction Products, Dental Alloys, Miscellaneous Applications for Metal Powders, Comparison of Physical Properties of Sintered and Fused Industrial Metals and Alloys, Survey of Sintered Metals and Alloys for Potential Industrial Use, Stress Analysis of Sintered Metal Structures, Appraisal of Testing Methods for Sintered Metals, Theories of Bonding and Sintering—Summary, and The Future of Powder Metallurgy.

It is probable that the theory chapter is of interest only to some powder metallurgists and very few others. The last chapter on the future is evangelical, with missionary zeal for further revelations.

Goetzel's two volumes include everything of the previously published works. He has achieved the aim of obsolesceing all predecessors in providing an estimable volume, extensively documented. Oh, that this had only

been digested, concentrated and reduced to its essences.

Just as Good

Equivalent Valves. By H. Gordon Hawes. Hooper Publishing Co., San Francisco. 168 pages. $15.

If you specify or purchase valves you should note the availability of this unusual volume. What Mr. Hawes did, in effect, was to combine the catalogs of 18 valve manufacturers. The material is broken down by (1) material, (2) type of valve, (3) catalog pressure rating. Suppose, for example, you want a brass valve, 100 lb. working steam pressure, non-rising stem. In "Equivalent Valves" you will find nine listed (four manufacturers) with catalog numbers and design features such as stem, bonnet, packing, connections, and disk and seat design. Take your choice. If you don't find exactly what you want, you (or your purchasing agent) will locate an "equivalent."

All the material has been checked by the manufacturers. Supplements will be available from the publisher at $6 per year to keep you up to date.—*LBP*

German Thinking

Distillation and Rectification. Second edition. By Emil Kirschbaum. Springer-Verlag, Berlin. 465 pages. DM 49.50.

Review by Donald F. Othmer

This second edition of Kirschbaum's authoritative textbook is essentially similar to the first one, with some revisions and amplifications which have increased the number of pages and illustrations by about 25 percent. The approach and organization is refreshingly different from American textbooks; but as a whole it should be regarded as up to date only with respect to German thinking and literature.

In the chapter on fundamentals the section on equilibria of multicomponent mixtures has been brought up to date; and information on azeotropic methods has been added. Likewise, the calculations pertaining to separation of multicomponent mixtures have been treated in greater detail. The mechanism of heat and material interchange on bubble plates has been investigated further, particularly as to the effect of variations in mass flow. The functional design of bubble towers and their elements is discussed at greater length, and some new tray types are presented. The paragraphs on refluxing methods, equipment, instrumentation, and con-

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trol might well be expanded. The same goes for data on cost factors. These important phases of plant design deserve more attention in a book written for engineers.

The chapter on packed columns has been largely rewritten and rearranged; that no molecular distillation has been omitted as warranting separate treatment. The section on phase equilibria of binary and ternary mixtures has been radically revised by Hermann Stage so that there are now 100 pages of physical data compiled by that contributor. These are incorporated as an appendix. It is noted that such authorities as Kellogg, Kirkbride, Maxwell, Brown and others are missing. The number of graphs of equilibrium curves has been increased to 22, and these include x,y curves for 158 binary systems and 7 ternary systems.

On the whole, Dr. Kirschbaum has selected his material with customary care and competence, from his own work and whatever outside information was available to him. Much of the scientific and technological progress achieved in this country has been omitted; possibly periodicals from this country have not been available.

On the whole, the book will find use by every engineer engaged in distillation work or design. He will find particularly valuable the several hundred excellent figures, mainly fine line-drawings of equipment, charts of data, and geometric presentations of calculation methods.

53 Compounds

INORGANIC SYNTHESIS. Volume III. Editor-in-Chief, L. F. Audrieth. McGraw-Hill Book Co., New York. 230 pages. $3.50.

Reviewed by Kenneth A. Kobe

The earlier volumes, published in 1939 and 1946, have shown a need for proved methods in inorganic chemistry. This third volume describes the preparation of 53 compounds and all preparations have been checked by independent laboratories. The increased activities in certain fields is reflected in the number of syntheses dealing with phosphates, polyphosphates, fluophosphates, and fluorine compounds. Directions and precautions for the use of fluorine and anhydrous hydrogen fluoride are given.

In addition to the syntheses, three short survey articles appear on basic beryllium derivatives of organic acids, organosilicon compounds and the

poly- and metaphosphates and the strong phosphoric acids.

The subject and formula indexes are cumulative for all three volumes.

All laboratories dealing with inorganic chemistry will need this book. The number of industrial laboratories that contributed to this volume is noteworthy, and it is hoped that the number will increase.

Reference

ANALYTICAL ABSORPTION SPECTROSCOPY. Edited by M. G. Mellon. John Wiley & Sons, New York. 618 pages. $9.

Reviewed by Dorothy M. Dodd

This book, dealing with absorption spectroscopy in the ultraviolet, visible, and infrared regions is rightly described as "written almost entirely from the viewpoint of what seems of most practical concern in a modern chemical testing and analytical laboratory" and is composed of chapters contributed by men who are well qualified to write on their respective topics. As is inevitable when so many collaborate in the writing of a book, there is some overlapping of material, but this is not serious. The general principles underlying absorption spectroscopy, appropriate terminology, and the chemistry of sample preparation are dealt with about as fully as possible in a book of this nature; well known color comparimeters, filter photometers, spectrophotometers, and their accessories, are described in some detail and the necessary optical and electrical information is given with a minimum of mathematical treatment; methods, techniques, and applications are admirably presented. Many useful and interesting tables, diagrams, and photographs are included together with extensive bibliographies for those desiring further, more detailed, information.

However, the following observations are in order:

Chapter 1 is entitled "Chemistry: Preparation of Systems for Absorptimetric Measurement" and is very informative and well written, but, unfortunately, as its title indicates, it deals only with the chemistry of sample preparation for the various types of absorptimetric measurement and contains nothing about the methods of preparation of solid and powder films, Nujol mulls, etc., for infrared absorption measurements.

Chapter 8, "Spectrophotometers: Infrared Region," though well organized and presented and containing valuable and interesting material on the origin of infrared spectra, optics, instrumentation, calibration, qualitative

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and quantitative analysis, techniques and methods, should have included tables showing the wavelength dependence of refractive index for the various prism, window, and cell materials ordinarily used in this spectral region. Descriptions of the lead sulphide cell and the Golay detector and information about the construction and use of infrared microspectrometers and polarizers would have been valuable additions.

The chapter arrangement of the book might be improved if Chapter 1, "Chemistry: Preparation of Systems for Absorptimetric Measurement," and Chapter 2, "Physics: General Principles of Absorptimetric Measurements," were reversed in order and if, in addition, Chapter 9, "Measurement and Specification of Color," preceded or followed Chapter 3, "Color Comparimeters." At present, Chapter 9, following "Spectrophotometers: Infrared Region," is more or less isolated at the end of the book.

The book as a whole is a fine reference text for those engaged in one or more of the various phases of absorption spectroscopy as well as for students preparing for work in these fields.

Eyeworthy

ADVANCES IN COLLOID SCIENCE. *Vol. III.* Edited by H. Mark and E. J. W. Verwey. Interscience Publishers, New York, 1950. 348 pages. $7.50.

Reviewed by C. J. Cavallito

The third volume of this series consists of seven chapters of somewhat heterogeneous scope with emphasis on physical chemistry of polymeric substances. J. H. De Boer presents an excellent chapter on "Atomic Forces and Adsorption" which has broad implications and should be of interest to physicist, chemist and biologist. A chapter by A. E. Alexander on "Surface Chemistry and Colloids" fell short of expectations. This important field is dealt with somewhat superficially and in spotty fashion. A section on biological problems, for example, is covered in only four pages with three references. "Quantitative Interpretation of the Electrophoretic Velocity of Colloids" is reviewed by J. T. G. Overbeek and includes rather thorough mathematical treatment. A short section on "Lyogels" by E. A. Hauser and D. S. le Beau is interestingly presented with examples taken primarily from the rubber field. P. O. Kinell and B. G. Ranby discuss "Ultracentrifugal Sedimentation of Polymolecular Sub-

stances" mainly from the theoretical view and include considerable mathematical treatment. A lengthy chapter on "Fatigue Phenomena in High Polymers" by J. H. Dillon is of particular interest to the rubber, fiber and plastic specialist. A chapter by S. R. B. Cooke, of specialized interest to the mineral industry on "Flotation" is included.

All chapters include literature references to at least 1947, some to as recently as 1949 and 1950. The quality of the paper and printing makes the book eyeworthy.

The Latest Dope

THE TECHNOLOGY AND CHEMISTRY OF ALKALOIDS. By Frank E. Hamerslag. D. Van Nostrand Co., New York. 319 pages. $6.50.

Reviewed by Edgar A. Steck

The considerable commercial value of a number of alkaloids has led to the development of broad and diverse literature, and much use of special art. It has been the purpose of the author of the volume at hand to provide a guide for those requiring information on the manufacture of alkaloids. Most of the work must needs relate to isolations from botanical material.

The introduction to the volume gives brief review on the occurrence, possible uses and biogenesis of alkaloids in the plant, and then a view on general methods employed in isolation and purification of the active material. Consideration given to the equipment and machinery is concise and satisfactory for application of the older methods, but the comments on use of the simpler, cheaper ion-exchange procedures are limited since their introduction is quite recent. The practical views on the general production of alkaloids should be helpful to factory operation and also a guide in isolation of certain other plant materials. Organization of the remainder of the book follows the same pattern for 18 alkaloids (or alkaloid groups): chemistry, sources, manufacturing methods, pharmacological properties and uses, and analytical methods. The types are considered in alphabetical order. As would be anticipated, the author has assembled the data on manufacture with particular care and the other features have been made supplementary. It would have been desirable to evalnate analytical methods more critically since a number of the tests mentioned may be confused when impurities are present. The sources of alkaloids are discussed in some detail,

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and in adequate perspective. Sufficient attention has been given to chemistry and pharmacology for the person interested in technology; some syntheses are given. The topics in alkaloids discussed include: aconite, arecoline, coca, colchicine, curare, ephedra, ergot, hydrastine and berberine, ipecacuanka, lobelia, nicotine, nux vomica, physostigmine, pilocarpus, sparteine, solanaceous type, veratrine, and yohimbine. While one may not consider alphabetical order as satisfactory for the classification of other technical data it seems acceptable here. The lack of information on adhatoda, anhalonium and senecio alkaloids is understandable in a brief and practical work. To have wilfully eliminated the cinchona and morphine alkaloids, however, is a major fault of the author despite the opinion expressed in the preface to this volume.

The arrangement of references is not particularly attractive and appears to be the result of careless handling. It is well that the typography does not have this fault. The book has been set well and has a practical, dark cover for rough use.

Rigorous Criteria

PHYSICO-CHEMICAL CONSTANTS OF PURE ORGANIC COMPOUNDS. By J. Timmermans. Elsevier Publishing Co., New York. 693 pages. $12.50

Reviewed by F. C. Nachod

Boiling points accurate to 0.05 deg., melting points to 0.1 deg., specific gravity to 0.02 percent—these are only a few examples of the rigorous criteria of purity for compounds to be included in this impressive compilation. It took a meticulous investigator such as Dr. Timmermans and the concentrated efforts of the International Bureau of Physico-Chemical Standards of Belgium over a period of a quarter of a century to bring this work to fruition. Entries for over 1,500 organic compounds are found and the literature coverage extends to Jan. 1, 1950.

This book will certainly find a large audience and it is hard to see how any reference library can go without this monograph.

Recent Books & Pamphlets

Synthetic Organics. "Synthetic Organic Chemicals; United States Production and Sales, 1949." Statistics cover crude organic chemicals derived from coal, natural gas, and petroleum; intermediates; and finished synthetic organic chemical products. 40 cents. U. S. Tariff Commission Report 169, Second Series, Superintendent of Documents, Washington 25, D. C.

High Polymers. "Bibliography of Recent Research in the Field of High Polymers." Reference list of both American and Foreign scientific papers. 20 cents. National Bureau of Standards Circular 498, Superintendent of Documents, Washington 25, D. C.

Census. "Census of Manufactures: 1947 Product Supplement." Quantity and value of shipments, and usually production, for more than 6,000 products manufactured by United States industry. Includes 1939 data for comparison, in many cases. $2.25. Superintendent of Documents, Washington 25, D. C.

Heaters. "Standard Code for Testing and Rating Steam Unit Heaters." Description of apparatus and method for testing, formulae required, nomenclature, instructions for computation of results and rating to a standard basis of comparison by graphical methods. 20 pages. Gratis. Second edition. Bulletin 10, Industrial Unit Heater Association, 2159 Guardian Bldg., Detroit 26, Mich.

Styrene Monomer. Properties and essential information for safe handling and use in manufacture, transportation, storage and laboratory application. 14 pages. 20 cents. Chemical Safety Data Sheet SD-37, Manufacturing Chemists' Association, 246 Woodward Bldg., Washington 5, D. C.

Safety. "Psychology of Safety in Supervision." Series of six training booklets for foremen and supervisors covers the relationship of psychology to accident prevention. By J. L. Rosenstein. 90 cents per set; double to non-members. National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

Fiberglas Bibliography. Annotated references to 710 articles describe development, manufacture, properties, forms and uses of Fiberglas materials. 88 pages. Gratis. Third edition. Owens-Corning Fiberglas Corp., Toledo 1, Ohio.

Illinois Institute of Technology. Outlines developments at the Institute during the last ten years. Covers education and enrollment at graduate and undergraduate levels; planning and building; financing; research for industry and government. By Henry T. Heald. 40 pages. Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Hydrogenation. "Review and Compilation of the Literature on Pressure Hydrogenation of Liquid and Solid Carbonaceous Materials." Over 2,500 digests. By J. L. Wiley and H. C. Anderson. 206 pages. $1.25. Bureau of Mines Bulletin 485, Superintendent of Documents, Washington 25, D. C.

German Industry. "German Chemical Industry. A Bibliography of the Chemical Metallurgical and Process Industries." Over 2,000 document references with descriptive titles or abstracts, and includes, in addition to a 6,000-entry subject index, author indexes, and cross-indexes with OTS, British and U. S. Military report numbers. By L. W. Greene. 396 pages. $10. PB 101458, Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

British Industry. "Simplification in British Industry." Second report of a British team which visited this country on behalf of the Anglo-American Council on Productivity. Indicates steps which are already being taken by British industry towards simplification. 14 pages. Gratis. Economic Cooperation Administration, Technical Assistance, New York Field Office, 2 Park Ave., New York 16, N. Y.

Automobile Chemicals. "Chemical Problems of the Automobile Industry." Amounts and kinds of chemicals used, new developments. By C. L. McCuen. 18 pages. General Motors Corp., 3044 West Grand Blvd., Detroit 2, Mich.

Water. "Industrial Water Resources of the St. Louis Area." Includes a series of ten graphs and charts recording variations in the water of the Mississippi, Missouri and Meramec Rivers. 40 pages. Industrial Bureau, St. Louis Chamber of Commerce, 511 Locust St., St. Louis 1, Mo.

Fertilizers. "Fertilizers—World Situation and Outlook." Food and Agriculture Organization of the United Nations. Commodity Report 10 August 1950. Mimeographed. 25 cents. Superintendent of Documents, Washington 25, D. C.

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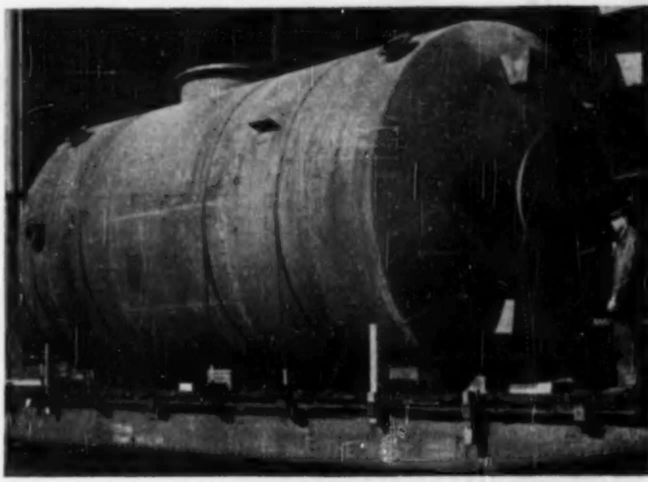

NEW TECHNICAL LITERATURE

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Conveyors 276A	Pictures a line of vibrating conveyors which operate at the exact natural frequency of their springs. Conveyor consists of a pan mounted on springs and vibrated by a motor driven eccentric. Applications, capacities, sizes, prices. 12 pages.	Whitley-Carrier Co.
Porous Media 276B	Filtration and diffusion applications for ceramically bonded media. Selection of proper porous material; how to design equipment for best results. Numerous charts, tables and illustrations supplement data on design, installation, operation, specifications. Section on filtration covers underdrains for water filtration, softening and demineralization, septa for diatomite filtration, direct liquid and gas filters. Section on diffusion covers design, types, grade—permeability of diffusers. 36 pages.	Carborundum Co.
Instruments 276C	Drawings and tabulated data on making, checking, selecting and ordering thermocouples; wire sizes and resistances and temperature-millivolt curves to aid in applying indicating, controlling and recording instruments. Resistance bulbs and wells, radiation detector, special thermocouples for plastic injection and extrusion machines, molten metal thermocouple for ferrous metals. 38 pages.	Wheelco Instruments Co.
Wetting Agents 276D	General discussion of surface activity and surface active agents; large fold-out chart gives properties and solubilities in 23 solvents of this company's agents. Explains in detail a system for selection as applied to choice of emulsifiers and choice of the agents for other purposes. 34 pages.	Atlas Powder Co.
Coatings 276E	Three tables of properties cover: strippable and permanent coatings for protecting metal against abrasion and corrosion, for thermal insulation of motor housings, for sound deadening of metal panels; adhesives for bonding metal, rubber, glass, plastics, and wood to themselves and other materials; sealers used in refrigerators, fuel tanks. 32 pages.	Minnesota Mining and Mfg. Co.
Pumps 276F	Centrifugal pump with concentric casing to promote streamlined flow. Application photographs, cutaway drawing and construction sketches, performance curves. 12 pages.	Mission Mfg. Co.
Mills 276G	Design features, performance data, ball segregation in mills consisting of two conical heads, a short cylindrical section and a longer tapered conical barrel. Typical flow sheets for wet and dry grinding applications, construction details, foundation drawings and dimensions. 12 pages.	Hardinge Co.
Speed Reducers 276H	All steel right angle motor reducer adaptable to horizontal or vertical drive applications. Selection, dimension and rating tables. 16 pages.	Falk Corp.
Corrosion Resistance 276I	Family of thermoplastic and thermosetting resins used in coatings, chemical tubing and piping, process equipment lining. Tables show resistance to various corrosive agents. 8 pages.	Munray Products Inc.
Pipe 276J	Pipe composed of asbestos fiber and cement for use in ducts, vents and stacks. Dimension tables and sketches of pipe, couplings, fitting and accessories. Photographs show some actual installations. 22 pages.	Johns-Manville
Grinder 276K	Mixing and fluid grinding mill for paints, enamels and other colloidal solutions. Photographs show construction and installation. 4 pages.	T. J. Laird Equipment Corp.
Wax 276L	Summarizes the history of wax through the ages, from the ancient Egyptians to this company's microcrystalline wax. 6 pages.	Bareco Oil Co.
Motor Accessories 276M	Two bulletins. One covers motor starters for 2,300 to 5,000-volt squirrel cage, wound rotor, synchronous and multi-speed motors. Photographs show operation and construction. 12 pages. The second covers an air break contactor for applications requiring frequent starting, inching, reversing, plugging. Cutaway drawings show parts; sketches show operation. 8 pages.	Allis-Chalmers Mfg. Co.
Equipment 276N	High capacity unit utilizing the principle of controlled vacuum flotation to remove solids, grit and scum from sewage and industrial wastes. Photographs, drawings, capacities and design data. Covers operating results of actual installations at several plants. 12 pages.	Dorr Co.
Fire Safety 276P	Air or mechanical foam. Illustrated and described are methods of application, high and low expansion types of foam compound, specifications and operating characteristics for five sizes of portable playpipes, mobile and stationary foam proportioning tanks, installations of the auto induction, pressure line inductor. 24 pages.	Pyrene Mfg. Co.
Equipment 276Q	Photographs help describe construction and application of a line of equipment for low-temperature evaporation and drying, vacuum rotary drying, solvent and byproduct recovery. Describes this company's facilities for testing customers' products or a semi-plant scale. 28 pages.	Blaw-Knox Co.
Gases 276R	Charts give prices and cylinder information on 74 rare and common gases. Automatic regulators and controls are illustrated and described. 12 pages.	Matheson Co.

(Continued)


List 50½ — (Short face to face), Rising Stem, Low Pressure, Double Disc Iron Gate Valve
List 25 — Rising Stem, Solid Wedge, Iron Gate Valve
CHAPMAN

New Technical Literature, cont...

SUBJECT	FEATURES	COMPANY
Steam Generator 278A	Steam generator utilizing two separate heat absorbing sections, each having its own independent circulating system, to reduce carryover of silica and total dissolved solids. Graphs, flow diagrams, cutaway drawings, show operating principle and applications. 12 pages.	Foster Wheeler Corp.
Equipment 278B	Grinding and mixing equipment including various types of jar mills, drum mixers and their parts. Photographs and tables give operational information. 16 pages.	U. S. Stoneware
Filters 278C	Sketches show complete operating cycle of this company's filters including a backwash system which permits cleaning without manual labor. Information on sizes, capacities and motors and descriptions of metals from which filters are constructed. 8 pages.	Titeflex, Inc.
Speed Reducers 278D	Worm gear speed reducers. Covers two types: one unit has the worm below the gear which operates directly in the oil bath while the other has the worm above the gear and the gear dips in the oil bath. Horsepower rating tables, efficiency curve, dimensional drawings. 36 pages.	Cleveland Worm and Gear Co.
Equipment 278E	Three bulletins. The first on steam condensers contains photographs showing construction and installations. Charts and curves amplify a discussion on determining heat transfer rates, pressure drop etc. 34 pages. The second contains dimensional and performance data, drawings and photographs of continuous centrifuges. 8 pages. The last covers a pneumatic sewage ejector system. Piping diagrams show use of air valve, electrode controls, and float switch. Layouts of single and duplex sewage ejector systems are sketched. 12 pages.	Condenser Service and Engineering Co.
Coatings 278F	Photographs and brief descriptions of the use of a baked-on phenolic resin coating or lining in the chemical, pharmaceutical, pulp and paper, food and other industries. 8 pages.	Lithgow Corp.
Materials Handling 278G	Three bulletins. One covers vibrating conveyors which can carry bulk and packaged materials, horizontally or up inclines to 10 deg. in open or enclosed troughs. Sketches and photos show operation. 4 pages. The second contains a photograph and operational sketches of a swivel piler on wheel mount which throws to a height of 20 ft. over a radius of 50 ft. 1 page. The third shows a swivel piler for conveyor mounting. 1 page.	Stephens-Adamson Mfg. Co.
Electrical Accessories 278H	Thermocouple connectors and panels. Duplex plugs and jacks made of thermocouple materials for standard calibrations. 4 pages.	Thermo Electric Co.
Motor Starters 278I	Photographs of synchronous motor starters keyed to line drawings explain operation. Covers polarized slip-frequency field application relay and pull out relay which protects the motor when it does not synchronize. 8 pages.	Westinghouse Electric Corp.
Instruments 278J	Photographs show a recording millivoltmeter. Discusses applications and specifications. 4 pages.	Bristol Co.
Materials Handling 278K	Electric tiering truck for handling double-faced pallets. Illustrations show it with telescopic frame raised to its full height and the non-telescopic model with the forks in a low position. 2 pages.	Lyon-Raymond Corp.
Instruments 278L	Twelve suggested applications of a pneumatically operated control mechanism for accurately combining input control pressures and spring forces to produce a single output control pressure. Cutaway drawing illustrates principles of operation and other drawings illustrate modifications of the basic design for special uses.	Hagan Corp.
Silicone Grease 278M	Two bulletins. One discusses performance of a line of four silicone greases, applications, properties. Photographs show the greases in use. 8 pages. The second covers a grease used in motor bearings: how, when and how much to use. 4 pages.	Dow Corning Corp.
Instruments 278N	Precision instrument and motor for uniformly expanding condenser and heat transfer tubes. Explains operation and design features. 8 pages.	Crane Packing Co.
Insulation 278P	Sheet material composed of asbestos fibers, diatomaceous silica and an inorganic binder. Recommendations for use as both insulation and construction material. Installation photographs, table covering structural and insulating properties. 4 pages.	Johns-Manville
Acidizing 278Q	One article describes a method for acidizing oil and gas wells, its history and significance. Another article discusses the use of acidizing to combat scale and sludge in boilers and other industrial equipment. 20 pages.	Dowell Inc.
Pipe 278R	Applications of plastic pipe and tubing. Picture sequences show proper installation methods for both. Curves show flow vs. head loss for plastic and for steel pipe for water. 8 pages.	Corrosion Engineering Co.
Materials Handling 278S	Equipment for vertical movement in both storage and production operations. Specifications and photographs of stackers, hoisters, portable cranes, working height lifters.	Lewis-Shepard Products Inc.
Equipment 278T	Illustrates and describes a line of mixing, grinding and agitating equipment and accessories. Sketches show equipment arrangements in various processing systems. 36 pages.	Patterson Foundry and Machine Co.
Detergents 278U	Inhibition of caustic soda attack on glass by a synthetic detergent. Describes tests on bottles and microscope slides. Tables and graphs aid in recording resulting data. 26 pages.	Allied Chemical & Dye Corp.
Packings 278V	Covers applications, structure and performance of self-	Green Tweed & Co.

(Continued)

RESISTANCE TO CORROSION

STRENGTH AT HIGH TEMPERATURES

RESISTANCE TO OXIDATION

EASE OF FABRICATION

TYPICAL ANALYSES: 301 - 302 - 302B - 304 - 308 - 309 - 309S - 309Cb - 310 - 314 - 316 316Cb - 317 - 321 - 329 - 330 - 347 - 403 - 405 - 410 - 416 - 430 - 443 - 446 Inconel* Nichrome**

*Registered U. S. Trade-Mark. **Trade-Mark Reg. U. S. Pat. Off.-D-H Co.

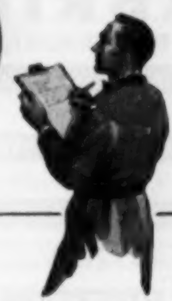
SEAMLESS OR WELDED

What's Your Job For Stainless Steel Tubing? . . .

Do The Job Best With The Best Tubing For The Job – Get

GLOBE

STAINLESS STEEL TUBES
Seamless or Welded



GLOBE TUBES

GLOBE SEAMLESS STAINLESS STEEL TUBES

GLOWELD WELDED STAINLESS STEEL TUBES

Globe produces 26 standard analyses of stainless steel tubes — also special analyses when required.

Globe seamless stainless steel tubing may be had in sizes from ½ inch to 6⅝ inches O.D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

Gloweld electric welded stainless steel tubing may be had in sizes ranging from ¼ inch to 5 inches O.D. inclusive; in standard weight pipe (schedule 40) sizes ⅛ inch to 2 inches — in light weld pipe (schedule 40) sizes ⅛ inch to 4½ inches inclusive.

Globe engineers gladly give you the benefit of specialized knowledge of stainless steel tubing in a wide range of services and applications — to improve your product — to cut costs.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis.
Chicago • Minneapolis • Cleveland • Detroit • New York • Philadelphia
St. Louis • Tulsa • Houston • Denver • San Francisco • Glendale, Cal.

Write for Bulletin 301 — Corrosion and Heat Resisting Steel Analyses Chart — a valuable reference tabulation of stainless steel analyses as produced by various manufacturers.

SUBJECT	FEATURES	COMPANY
	lubricating, molded and sheet packings, both standard and special. 16 pages.	
Materials Handling 280A	Specifications are tabulated below photographs of fork-lift trucks, both gas-powered and electrics, on solid tires and pneumatic tires; industrial towing tractors; truck tractor models for handling bulk materials. Special attachments are listed. 8 pages.	Clark Equipment Co.
Gages 280B	General information and features of standard gage types, photographs. 4 pages.	Jerguson Gage & Valve Co.
Motors 280C	Sanitary motor enclosed for protection from drippings and other settlings. Cross-sectional view, numerous installation photographs. 8 pages.	U. S. Electrical Motors Inc.
Sifter 280D	Photographs show all-metal gyratory sifter and its parts. Operation, applications, cleaning. 2 pages.	Allis-Chalmers Mfg. Co.
Water Treatment 280E	System for treating boiler feed water. Development, filtration, backwash water, direct contact vent condenser, complimentary recirculation, backwashing, proportionate sludge removal, application of the system. 6 pages.	Worthington Pump and Machinery Corp.
Fans 280F	Centrifugal type fan with backwardly curved blades mounted within a weather-proof chamber; welded steel framework. Operation, dimensions, capacities. 4 pages.	Sturtevant Co.
Hose 280G	Flexible metal hose. Section one includes interlocking high pressure hose, air jacketed hose for diesel exhausts, conveyor hose for ventilating and exhausting. Second section refers to flexible metal seamless high pressure hose and diesel exhaust hose.	Atlantic Metal Hose Co.
Alumina 280H	Picture sequence shows chemical treatments and processes used to extract alumina from raw bauxite ore in this company's Hurricane Creek, Ark., plant. 12 pages.	Reynolds Metals Co.
Cements 280I	Resin, sulphur, silicate and asphaltic cements. Properties of each are given in chart form.	Atlas Mineral Products Co.
Instruments 280J	Operation of an instrument which makes automatic titrations. 1 page.	Beckman Instruments Inc.
Handling 280K	Illustrates a line of corrugated steel board, skids, pallets and combination units. 24 pages.	Union Metal Mfg. Co.
Instruments 280L	Instruments for recording and indicating such variables as temperature, resistance, conductivity, strain, position. Pneumatic and electric-operated automatic control models are also covered. Reproductions of chart records, schematic drawings, installation photographs.	Bristol Co.
Rubber Pipe 280M	Compares applications and comparative qualities of rubber as against metal pipe. Case histories and recommended applications. 8 pages.	Hewitt-Robins, Inc.
Materials Handling 280N	Pictures a line of industrial castors in various wheel sizes, with illustrations keyed to the specification chart. Construction details of the plastic, rubber and steel wheels available. Platform and hand trucks are also covered. 36 pages.	Rapids-Standard Co.
Drives 280O	Automatic variable pitch drive covering most speed changing needs from 1½ to 40 hp. Instructions and tables to help figure components needed to assemble a drive for various speed ranges and horsepowers. 12 pages.	Allis-Chalmers Mfg. Co.
Air Conditioning 280P	Chart gives simple instructions on how to apply air meter in checking up on air heating and cooling system operation.	Anemostat Corp. of America
Mixers 280Q	Three bulletins. One covers top entering propeller mixers. Sketches and a nomograph accompany selection and construction information. Various models are pictured and sizes and specifications tabulated. 8 pages. The second is on side entrance mixers. Photographs, design sketches and specifications for various models and their parts. 8 pages. The third illustrates and describes this company's complete line of liquid and dry process mixers. Engineering drawings, specifications charts, installation photographs. 40 pages.	International Engineering, Inc.
Equipment 280R	Equipment used for automatic heat and automatic power installations. Three major sections cover 1) packaged steam generators, oil and gas burners, ranges, water heaters, bake ovens and other heavy equipment; 2) oil, gas and other accessories; 3) design and installation data on oil and gas fired heating, hot water and power plants. $2.50. 160 pages.	Preferred Utilities Mfg. Corp. 1860 Broadway, New York, N. Y.
Linings 280S	Linings for steel drums and pails to protect such products as animal and vegetable oils and fatty acids, products of oil refiners, strong solvents. 12 pages.	Glidden Co.
Antioxidant 280T	Properties and uses of a hindered phenol type antioxidant. Suggested for use in rubber and for possible use in the stabilization of paraffin wax, animal fats and oils, vegetable oils, soaps.	American Cyanamid Co.
Valves 280U	Teflon seated needle and plug gate valves. Cross-sectional views, dimensions, materials of construction. 4 pages.	Alloy Steel Products Co.
Equipment 280V	Heat exchangers, evaporators, feedwater heaters, pressure vessels and pipe. Operational, design and selection data. Cutaway drawings, pages of photographs showing a variety of installations. 16 pages.	American Locomotive Co.
Cellulose Gum 280W	Sodium cellulose sulphate. When it is dissolved in water, the viscosity of the solution increases rapidly. Physical properties, toxicity, stability, compatability and suggested uses. 8 pages.	Tennessee Eastman Corp.

A "K" Monel doctor blade in use on a soap flaker dryer roll. After 7 months of highly satisfactory service, this blade was transferred to rolls used for polishing soap, setting a record for doctor blade longevity in the plant.

The Doctor Was a Headache

...until they tried "K" MONEL

In a soap flake plant, flaker roll doctor blades were a source of considerable trouble and expense.

The blades were operated against a cast iron cooling roll, 5 ft. in diameter with a 90 in. face, which handled 72,000 pounds of soap every 24 hours.

Although made of the finest Swedish steel, doctor blades had to be honed every hour, and reground every 24 hours. It took only ten minutes to change a blade, but in that short time 500 pounds of soap production were lost.

After putting up with the problem for some time, plant engineers decided to try doctor blades made of "K" Monel®.

Results? Judge for yourself! Here is what the plant engineers reported:

1. "K" Monel doctor blades (0.031 in. thick by 4 in. wide) required honing only once in 24 hours.

2. "K" Monel blades gave 27 continuous days of service before needing regrinding.

3. It took more than 7 months to reduce the width of a "K" Monel blade from 4 in. to 2¾ in.

Switching to "K" Monel doctor blades gave them 24 times more service between honings, 9 times more service between regrinds, and saved uncalculated production poundage formerly lost through frequent blade changes.

Not always, of course, can such spectacular gains be made merely by changing the material of a doctor blade. But here's something to remember—

There are special Inco Nickel Alloys for almost every doctor blade application . . . alloys that have a proved record of reducing maintenance costs and speeding production

Find out more about these important alloys by asking for your copy of: "How to Get More Production from Doctor Blades." Remember, too, that Inco's Technical Service Department is always ready to help you solve corrosion and high-temperature metal problems.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE

NICKEL INCO ALLOYS

MONEL® • "K"® MONEL • "KR"® MONEL • "R"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"®

Chemical Economics

RICHARD F. WARREN, Market Editor

Defense Demands Bite Deeper Into Industrial Needs of CPI

As 1950 neared an end, military and other defense needs began to exert a sizable impact on producing capacities. By the end of December the CPI will have chalked up another record production year. Business in 1950 has far exceeded the most optimistic forecasts. Both profits and sales in the chemical process industries hit new peaks. Thirty six leading chemical companies show an average gain of 20 percent in dividend payments above the corresponding first nine months of 1949. Twelve of these firms paid amounts ranging from 25 to 100 percent more than they did in the previous year.

Supply & Demand

- **Prices climbed again this month but rate of increase eased. See price indexes on next page.**
- **Manpower supply is getting tight. It will get tighter next year and will stay that way for some time.**
- **Synthetic fiber demand continues high. Nylon may be produced by Chemstrand. Du Pont will build a Fiber V plant in Kinston, N. C.**
- **Capital expansion plans mean a big production capacity growth for chemical industry next year.**
- **Sales by major chemical firms point to new records in 1950.**

Growing Pains—Demand for raw materials has risen to the point where supplies of basic materials can not keep up with the fast-moving pace now being set in the major chemical consuming industries. Byproducts of the coke ovens are not sufficient to meet demand. Solvents like alcohol, ketones, and esters which were searching for markets in 1949, can not supply consumers with all their needs in 1950.

Sulphur—basis for most of our sulphuric acid supply is having difficulty in meeting the demands placed on it by a 12,500,000 ton per year acid market (see *Chemical Engineering*, Nov. 1950, p. 321). Sulphur stocks have dropped more than 500,000 tons as acid consumption jumped 2.4 million tons above the 1949 rate. This hike in consumption is almost equal to the entire demand in 1932. It is almost double the 1941 acid requirements. This fabulous growth of sulphuric acid illustrates the vast expansion that has taken place in the chemical industry and the process industries in the past few years. It has resulted in a 20 percent cut in allocations by producers.

Unfortunately when rapid growth takes place, there are always bottlenecks which appear without warning and slow up the growth of major consuming industries. Today we are faced with the problem of trying to maintain a peak peace time economy and at the same time meet the needs of a large defense program. A major difficulty facing some producers is that they do not know how much of their output will be needed in the defense effort. This is one of the headaches the government planners are trying to eliminate. Until this problem is solved, many firms in the chemical process industries are going to face an uncertain supply situation.

Capital Expansion—The solution to some of our present bottlenecks can be found in the expansion of existing production units. Evidence of the steps being taken to build new units and improve old plants can be found in the amount of money being spent for capital expansions. Outlays for new manufacturing plants and equipment were running at an annual rate of $8.8 billion during the last half of 1950. The chemical process industries contribute about a third to this total. All indications point to a higher spending rate for these items in 1951.

Steel and related capacities will be increased considerably next year. Already plans for expansions totaling 1.7 million net tons in blast furnace capacity have been announced and major steel firms also indicate that at least 9.4 million net tons of capacity will be installed in the next two years. This growth should mean bigger supplies of coal-tar chemicals.

An example of this byproduct chemical growth can be seen in Republic Steel's $30 million contract with Koppers to build a complete new coke-oven plant containing byproduct chemicals units, along with four 275-ton open hearth furnaces at its Cleveland district plant.

Manpower—Labor supply has been getting progressively tighter. Most people do not realize how completely we are utilizing our available working force. Unemployment has dropped from 4.7 million in February to 1.9 million in October. According to a study made by McGraw-Hill's department of economics, there are only two areas with heavy labor surpluses. They are in the mining districts around Wilkes Barre and Scranton, Pa. Important occupational shortages now exist in about a third of our producing centers. These shortages include engineers as well as several types of skilled plant labor. So far these shortages are confined to the Great Lakes area, the Southwest and the West Coast. However, they are spreading rapidly to other areas.

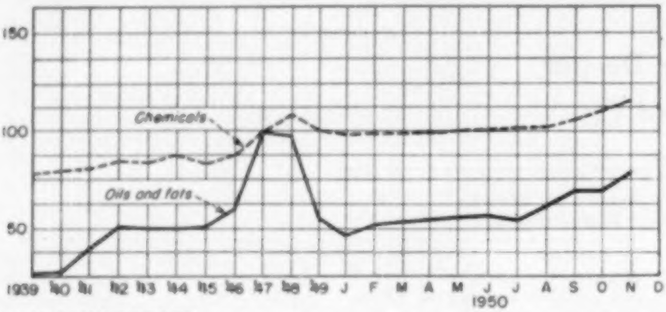
Soon the military program is going to get rolling and then a new special demand for skilled labor will be created.

When this happens a real labor pinch is going to develop. There is some difference of opinion on how bad this will get in 1951, but there seems to be agreement on the fact that labor will be extremely tight by the middle of the year. The McGraw-Hill survey points out that we will need 3-4 million more people in the army and defense industries during the next six months to a year. Additions to the labor force in this period are expected to be less than 3 million. Close to a million people will have to be drawn from non-essential industries.

This points up the need for planning manpower requirements in process industries plants now and training programs to fill these needs. With an estimated 10 year growth in our population of older persons and school children of more than 30 percent—while our working force grows only 6 percent—we are faced with a long term manpower problem. The nation will have greater needs with very few more people to turn out our products.

PRICE, CONSUMPTION AND PRODUCTION TRENDS

PRICES

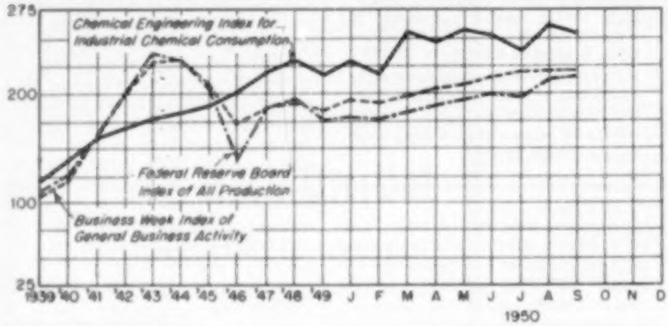


Chemical Engineering's Price Index a month, a year, and two years ago

	Chemicals	Oils & Fats
As of December 1	115.44	82.77
Last month	114.68	78.73
December 1949	99.34	47.93
December 1948	110.48	86.29

1947 = 100

CONSUMPTION



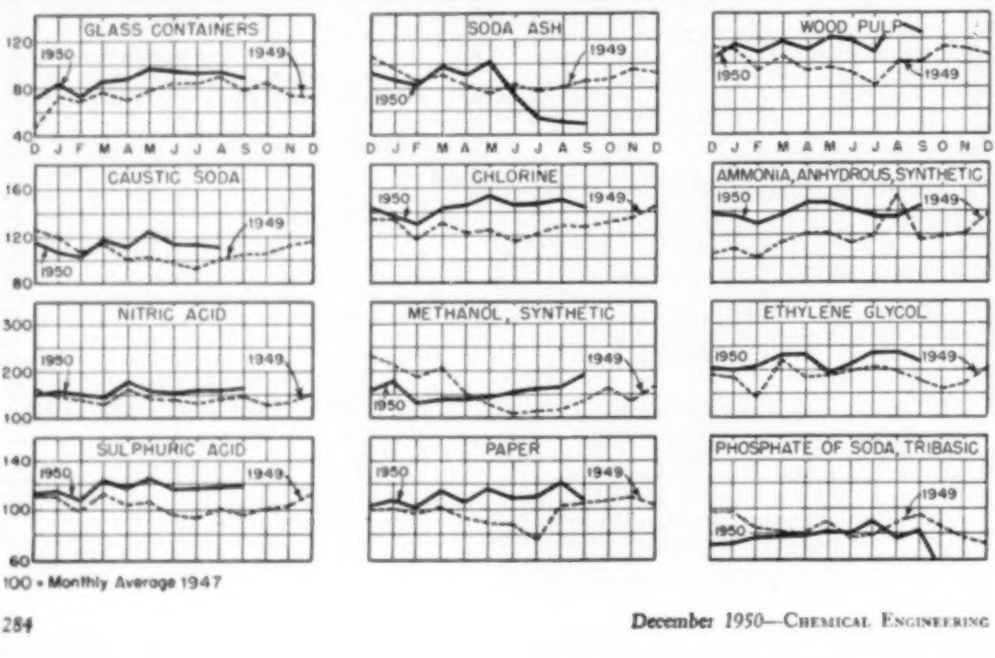
Chemical Engineering's Consumption Index for Industrial Chemicals

(A breakdown by consuming industries)

	August (Revised)	September
Fertilizers	50.95	51.80
Pulp and paper	28.70	26.26
Petroleum refining	24.50	23.42
Glass	21.35	20.60
Paint and varnish	30.01	28.98
Iron and steel	15.11	15.06
Rayon	32.41	30.50
Textiles	11.40	11.55
Coal products	11.02	10.55
Leather	4.81	4.25
Explosives	12.36	8.94
Rubber	6.45	6.41
Plastics	17.62	15.55
INDEX	266.69	253.87

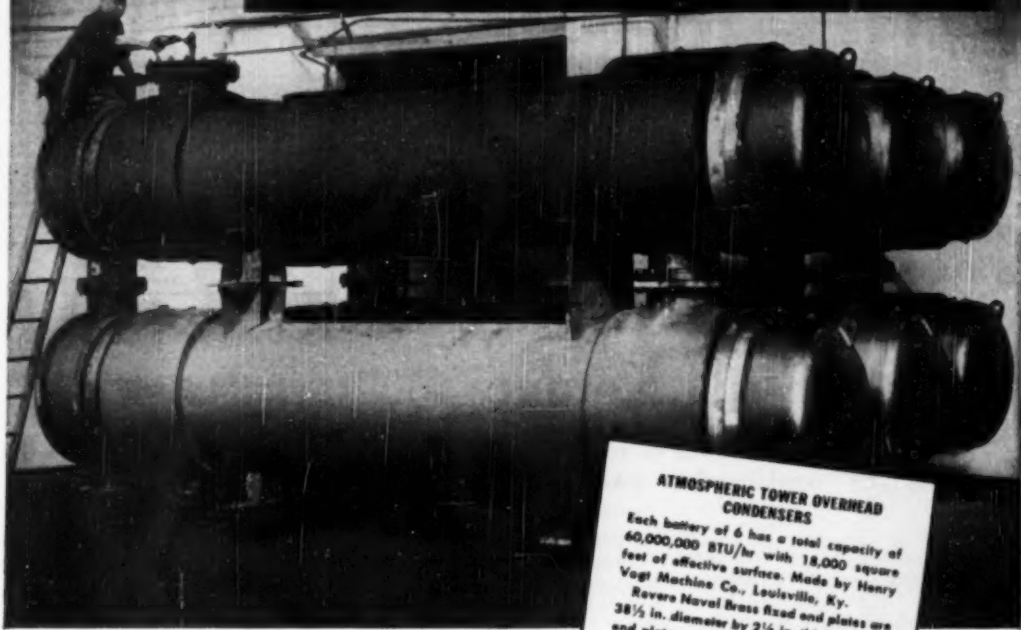
1935 = 100

PRODUCTION



100 = Monthly Average 1947

"Even *the* UNUSUAL can include *the* CONVENTIONAL"—REVERE



ATMOSPHERIC TOWER OVERHEAD CONDENSERS

Each battery of 6 has a total capacity of 60,000,000 BTU/hr with 18,000 square feet of effective surface. Made by Henry Vogt Machine Co., Louisville, Ky.

Revere Naval Brass fixed end plates are 38½ in. diameter by 2⅛ in. thick, floating end plates are 35¾ in. diameter by 2 in.

These Henry Vogt Machine Co. condensers have an unusual feature: vapor belts in the shells to feed more copious and uniform flows of vapor than are obtained by the usual single nozzles.

Inside the condensers, the tubes are rolled into Revere Naval Brass Tube Sheets.

The use of Revere Naval Brass for this purpose is completely conventional in condenser building practice. Revere Naval Brass is corrosion resistant, strong, tough, durable. Every mechanic on the production line knows how to fabricate it. Every maintenance man knows how to treat it when doing a servicing job. Thousands of Revere Naval Brass plates are in daily use in condensers and other heat exchangers built by all the best manufacturers. Some of these plates have been in service for decades.

Revere has alloys for your unusual design features too. Some of these are conventional, made to do unusual jobs because the Revere Technical Advisory Service knows where and when to recommend them. Others are less well known.

When you work out an unusual design you want to concentrate your attention on the unusual features. Under those conditions, use the time tested, service proven, utterly dependable standard Revere alloys in the standard parts of your design and you will be able to forget those parts and keep your attention where it is needed.

For any problem at all that involves the use of metals, consult the Revere Technical Advisors. Their knowledge, skill, experience, contacts (yes, we ask questions as well as answer them) can add up to money in the bank for you.

REVERE

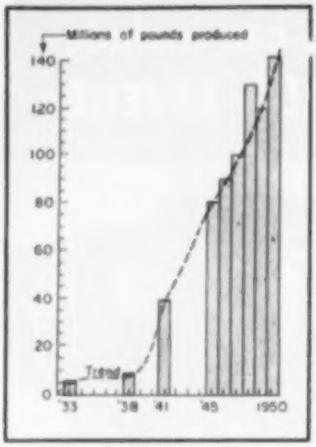
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y

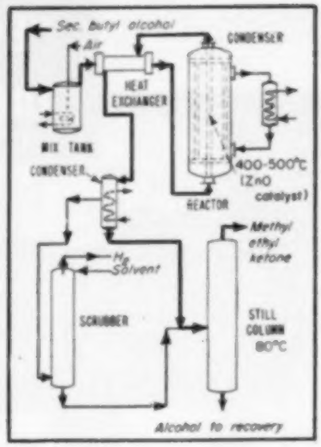
Sales Offices in Principal Cities, Distributors Everywhere.



PRODUCTION

Shell Chemical Corp.
Domingues, Calif.
Martinez, Calif.
Houston, Tex.
Esso Standard Oil Co.
Bayway, N. J.
Carbide and Carbon Chemicals Div.
Whiting, Ind.
Carthage Hydrocol
Brownsville, Tex.

PRODUCERS



PROCESS

Methyl Ethyl Ketone

Next to acetone, it is our biggest commercial ketone. We may need more.

Methyl ethyl ketone is our second largest commercial ketone. It is outranked only by acetone. It is similar to acetone in solvent action and has a lower solubility in water. It also has a lower vapor pressure and thus a higher boiling point. These factors give MEK an advantage over acetone when points other than solvent power are important.

Currently Shell Chemical Corp. and Esso Standard Oil make about 95 percent of the 140 million pounds produced annually. The basic process used by Shell and Esso is simple. They dehydrogenate secondary butyl alcohol to form methyl ethyl ketone and hydrogen. The alcohol is converted to the vapor state and passed through a reactor containing a catalyst of zinc oxide or some other suitable material. The temperature is about 500 deg. C. and the reaction takes place at atmospheric pressure. Yields of about 88 percent MEK are achieved.

The reaction generates considerable heat. Therefore the reactor is cooled by circulating a cooling fluid in the reactor. The reactor gases are used in preheating the reactor feed. They are then passed to a brine cooled condenser. The condensed MEK is passed to the still column. The remaining vapors pass to a scrubbing tower where they are scrubbed with a solvent to remove any remaining alcohol or ketone from the hydrogen gas. The bottoms of the scrubber are then carried to the distillation column where the MEK is removed from the top of the column and the remaining alcohol is drawn off and recovered from the bottom.

About 5 percent of our domestic supply comes from firms like Carbide and Carbon Chemicals Division which produces some in connection with its operations at Whiting, Ind. The Carthage Hydrocol unit at Brownsville, Tex., will be producing about 4-5 million pounds per year as one of the byproducts in the synthetic fuel operation.

Celanese also gets some MEK in its propane-butane oxidation operations at Bishop, Tex. However, it does not cut it out of the stream in a pure form. It is sold as a proprietary solvent mixture that contains both MEK and tetrahydrofuran.

The uses of MEK have followed an interesting cycle. It is primarily used as a solvent. In the early years of its commercial development it had a tough road to hoe. First full-scale operation got under way when Standard Oil Co. of New Jersey sold a few tank cars of secondary butyl alcohol for conversion to MEK in 1929. In the fall of 1930 Shell had a small unit running. Then in 1932-33 Standard Oil of New Jersey began making small amounts at Bayway, N. J. Total output was quickly boosted by Shell with construction of a larger unit at Martinez, Calif. Sales didn't grow rapidly until General Motors, looking for lacquers with a heavier solid content found that MEK would fill their needs. This was in 1938. Along with this demand in the nitrocellulose lacquer field there was a growing prewar market for MEK in vinyl coatings.

When World War II arrived the demand in the vinyl market soared. At the end of the war MEK played a large role in putting the surplus aircraft and ships along with much of our ordnance into "mothballs." It was used as a solvent in the vinyl cocoons spun around our planes, ships and guns. It has also been used in storing and shipping expensive heavy commercial machinery.

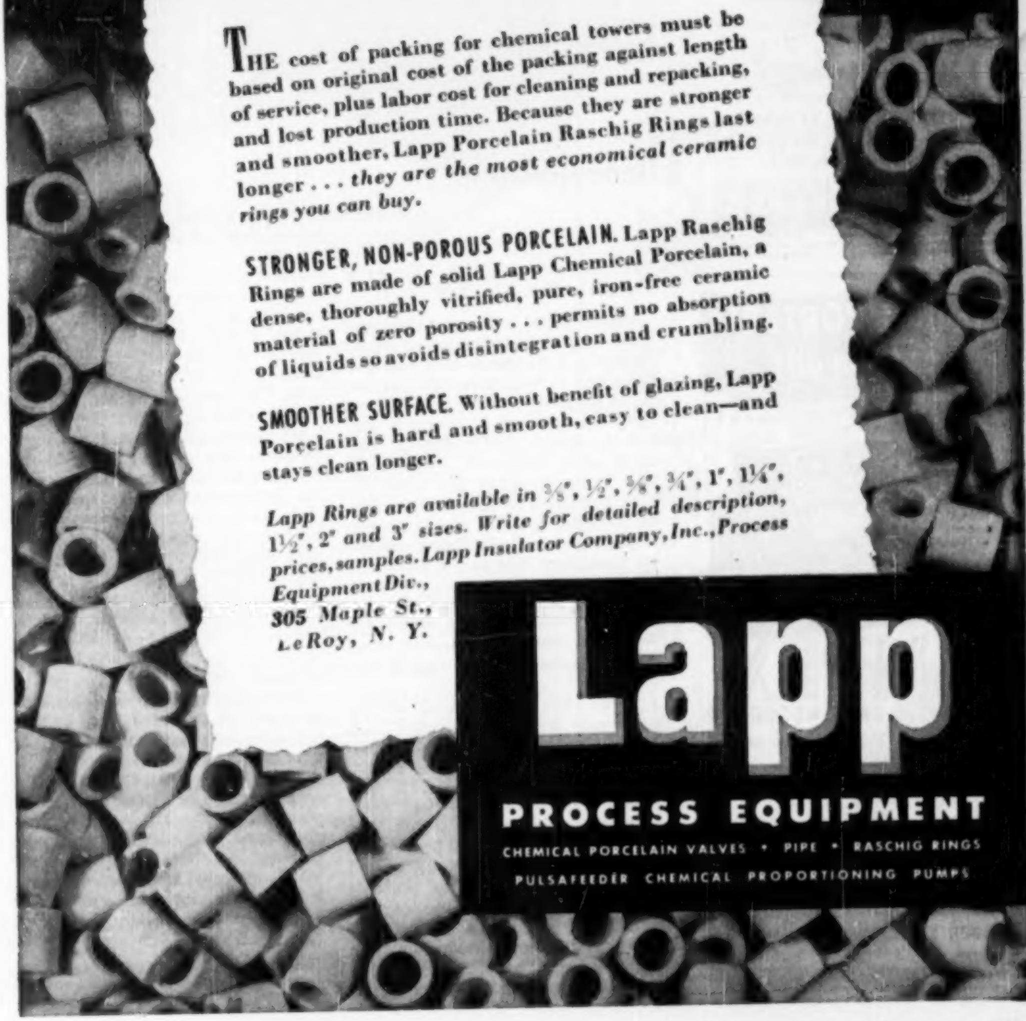
Today vinyl resin coatings and nitrocellulose lacquers consume about 120 million pounds (86 percent) of the MEK produced each year. The solvent dewaxing takes about 8 million pounds per year. However, this use includes some charging of new units—so a true long-term trend in this market is difficult to plot. In plants like Cit Con's new unit at Lake Charles, La., a blend of MEK, benzene and toluene is used. In other units MEK and benzene are used. Acetone-toluene-MEK is another ketone-hydrocarbon dewaxing blend which may be employed. There are 50 lube-oil plants in the world using the MEK type dewaxing process.

Although the vinyls are soluble in many solvents, MEK and MIBK (methyl isobutyl ketone) permit for-

(Continued)

their LONG LIFE *makes* LAPP PORCELAIN RASCHIG RINGS

the most economical tower packing you can buy



THE cost of packing for chemical towers must be based on original cost of the packing against length of service, plus labor cost for cleaning and repacking, and lost production time. Because they are stronger and smoother, Lapp Porcelain Raschig Rings last longer . . . *they are the most economical ceramic rings you can buy.*

STRONGER, NON-POROUS PORCELAIN. Lapp Raschig Rings are made of solid Lapp Chemical Porcelain, a dense, thoroughly vitrified, pure, iron-free ceramic material of zero porosity . . . permits no absorption of liquids so avoids disintegration and crumbling.

SMOOTHER SURFACE. Without benefit of glazing, Lapp Porcelain is hard and smooth, easy to clean—and stays clean longer.

Lapp Rings are available in 3/8", 1/2", 5/8", 3/4", 1", 1 1/4", 1 1/2", 2" and 3" sizes. Write for detailed description, prices, samples. Lapp Insulator Company, Inc., Process Equipment Div., 305 Maple St., LeRoy, N. Y.

Lapp

PROCESS EQUIPMENT

CHEMICAL PORCELAIN VALVES • PIPE • RASCHIG RINGS

PULSAFEEDER CHEMICAL PROPORTIONING PUMPS

mation of low-viscosity, high-solids solutions. Amount of MIBK used is increased in cases where the formulation is to be spray-applied.

Adhesives is another end-use that has found a place for the viscosity characteristics of MEK. Adhesives containing MEK have good aging characteristics—their viscosity does not increase in storage. Solvent formulations for adhesives using the newer types of synthetic resins and synthetic rubbers are generally similar to the formulations used in preparing surface coatings, but the adhesive solvents generally contain a higher ratio of MEK to permit the rapid build up of bonding strength.

The price history for MEK follows a familiar pattern. In 1933 the price was 12.5 c. per lb., by 1934 it had fallen to 8.5 c. per lb. as new output looked for markets. From 1934 to 1939 it fell steadily to 6 c. per lb. Then as demand picked up and war pressures increased, it rose to 7 c. per lb. in 1941. In 1942 it was up to 9 c. per lb. and held this level until 1949. Today it sells for 10 c. per lb. in tank car quantities.

In spite of the rapid growth shown on the production graph, we still need more MEK. Demand is currently pushing production along at capacity rates and material is still in extremely short supply. It will remain tight for some time to come, according to some industry experts. However, production did not hit capacity rates until the middle of the year and some feel that with production far above past rates next year, existing needs can be met. They are taking a "wait and see" approach to the problem.

Another factor influencing the supply situation is the availability of esters that compete with the ketones in the solvent formulations. High on this list is ethyl acetate. This ester depends on ethyl alcohol (its raw material) to establish its price level. With alcohol in short supply and currently at a high rice, MEK will grow more competitive with it.

Benzophenone

A perfume raw material, it is broadening its markets as production grows.

H. K. Vanderhoef, *Kay-Fries Chemicals, Inc., New York N. Y.*

Benzophenone is changing from specialty status to a general intermediate. Originally it was made as a perfume ingredient. It has maintained that use but is reaching into the field of synthesis. Its expected expansion is limited at present. Benzophenone, like many other chemicals, is produced from extremely tight raw materials. Both chlorine and benzene deriatives are involved in either of two general producing methods. Of course, defense use could alter this supply picture.

Producers

Fries Brothers, Inc., New York, N. Y.
Givaudan-Delawanna, Inc., Delawanna, N. J.
Kay Fries Chemicals, Inc., New York, N. Y.
Trubek Laboratories, Inc., East Rutherford, N. J.

In the 1949 Tariff Commission Report, only four manufacturers were listed. Although there were six manufacturers in 1936, production has increased from 14,000 lb. in 1936 to a total of 99,000 pounds in 1947. Since then the production has settled back to a 77,000 lb. total. These figures represent an end-use, currently limited to the perfume trade. They probably do not indicate the true use-potential of benzophenone. Earlier this year Kay-Fries announced production of an "intermediates" grade. This grade meets all specifications of the regular perfume grade except odor. The price is approximately 25 percent lower than that of the perfume grade. These factors should aid expansion of the use of benzophenone in synthetic work. Large scale production may lower the price still further.

Benzophenone was first prepared by heating calcium benzoate. It was mentioned as early as 1834. In 1884 the Friedel-Crafts reaction made possible the production of large quantities. Until the present time, benzophenone has been used widely to obtain strong basic odors with rose and jasmine oils in perfumes. It has great value in soaps as a fixative and anti-oxidant, especially with rose, geranium, balsam, oriental and similar heavy odors. It is stable and does not discolor in either creams or soaps.

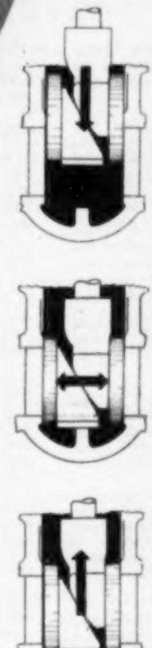
The halogenated isomers have been patented as dielectric or cooling mediums for electric appartaus. The semi-carbazone is named as an insecticide in a patent assigned to the government. The reaction of benzophenone to give an important hypnotic and anti-convulsant is also patented. Certain anti-histaminics may be prepared from benzophenone. It has been mentioned as a major part of a patented mixture for the absorption of certain gases.*

* A technical data bulletin listing reactions and properties has been published by Kay-Fries Chemicals, Inc.

DARLING VALVES FOR PLUS VALUES, JOB PROVED AGAIN AND AGAIN

Sound idea on trouble-free valve performance

...AND SO SIMPLE!



Gate descending. Fully revolving discs, independently hung, change seating position at each closing and assure uniform wear distribution. Assembly of discs and wedges is foolproof . . . requires no auxiliary links or holding devices.

Gate lowered. Faces of upper wedge are radiused and faces of both wedges are transversely beveled for uniform distribution of wedging pressure and positive closing even if valve seats get out of parallel due to valve body distortion.

Gate rising. Wedging pressure on both discs is entirely released before discs start to rise. Complete absence of wedging pressure in both upward and downward movement assures easy operation and eliminates severe friction and galling.

RELIEF from the most common time-and-money-wasting gate valve troubles—that's what the feature shown in the above cutaway view offers you. It's the Darling fully revolving, double disc, parallel seat principle . . . thoroughly proved in practically every fluid and gas handling service.

Note that there are only four simple working parts—two husky wedges and two plain, no-pocket discs that can't collect sediment. The discs can be interchanged for *extra* life. Maintenance is simplicity itself . . . assembly foolproof.

Check the diagrams at right. They show how this Darling principle assures such important advantages as easy, tight closing . . . automatic adjustment for valve body distortion . . . elimination of disc-to-seat galling . . . uniform wear distribution . . . and service life seldom if ever equalled.

DARLING VALVES FOR EVERY NEED

Darling parallel seat gate valves are available in a wide range of sizes and constructions for all kinds of normal and unusual service, and for pressures up to 1500 pounds. Corrosion resistant types include iron body, plain or rubber lined, with special alloy trim, cast steel, all bronze, special alloys or combinations as required. Send for a complete descriptive bulletin or specific recommendations on the proper valves for your particular service.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.

NEW CONSTRUCTION

	Current Projects		Cumulative 1950	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	$1,000,000	$4,100,000	$2,472,000
Middle Atlantic	....	2,061,000	2,510,000	35,230,000
South	$500,000	48,000,000	63,268,000	229,872,000
Middle West	12,000,000	5,706,000	22,426,000	58,384,000
West of Mississippi	11,000,000	2,511,000	108,200,000	140,972,000
Far West	....	1,034,000	21,236,000	18,077,000
Canada	....	....	21,926,000	31,156,000
Total	$23,500,000	$60,911,000	$244,066,000	$516,172,000

Proposed Work

Ill., Des Plaines—Universal Oil Products Co., 310 South Michigan Ave., Chicago, plans to construct a research laboratory. Estimated cost $2,000,000

Ky., Louisville—E. I. du Pont de Nemours & Co., Inc., 1374 South 2nd St., plans construct an addition to its plant here to include three new buildings. Estimated cost $500,000

Mich., Midland—Dow Chemical Co., Midland, plans to construct a plant to manufacture "Styron". Estimated cost $500,000

O., Mt. Vernon—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans to enlarge its plant here. Estimated cost $2,000,000

Tex., Borger—Phillips Chemical Co., Borger, plans to construct a carbon black plant. Estimated cost $3,500,000

Tex., Texas City—Carbide & Carbon Chemicals Corp., Texas City, Tex., plans to enlarge its plant here. Estimated cost $7,500,000

Wis., Superior—Western Oil & Fuel Co., 227 Colfax Ave., N., Minneapolis, Minn., plans to construct an oil refinery. Estimated cost $7,500,000

Contracts Awarded

Calif., South Gate—Firestone Tire & Rubber Co., 2525 Firestone Blvd., has awarded the contract for a warehouse to Oltman's Construction Co., 810 East 18th St., Los Angeles. Estimated cost $1,034,000

Conn., Naugatuck—U. S. Rubber Co., Maple St., has awarded the contract for Building No. 5, to W. J. Megin, Inc., 51 Elm St. Estimated cost $1,000,000

Fla., Cantonment—St. Regis Paper Co., Cantonment, has awarded the contract for an additional mill unit to Merritt—Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $20,000,000

Fla., Jacksonville—St. Regis Paper Co., Pensacola, has awarded the contract for complete kraft pulp and paper mill on St. Johns River near here to Merritt-Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $10,000,000

Ga., Atlanta—Goodyear Tire & Rubber Co., c/o Ive H. Hardin, contractor. 1000 Peachtree St., N, E., Atlanta, will construct a warehouse on Piedmont Rd. Estimated cost $220,000

Ill., Chicago—American Cyanamid Co., 3305 North Kimball St., has awarded the contract for a 1 and 2 story warehouse and office building to J. Emil Anderson, 1809 Balmoral St. Estimated cost $1,000,000

Ill., Chicago—Cromwell Paper Co., 3048 West 48th Pl., has awarded the contract for a factory to Heidel & Beck, 6235 South Michigan St., at $145,000

Ill., Franklin Park—Fearn Laboratories, Inc., 9353 West Belmont St., has awarded the contract for an addition to its plant to L. A. Marconi Co., 767 Milwaukee St., Chicago. Estimated cost $210,000

Ill., North Chicago—Fansteel Metallurgical Corp., 2200 Sheridan Rd., has awarded the contract for an addition to its plant to John Griffiths & Son Co., 228 North LaSalle St., Chicago. Estimated cost $100,000

Ill., Ottawa—Libbey-Owens-Ford Glass Co., Nichols Bldg., Toledo, has awarded the contract for a tank furnace for manufacturing plate glass blanks to A. Bentley & Sons Co., 201 Belmont St., Toledo. Estimated cost $3,000,000

La., Lake Charles—Continental Oil Co., Oil & Gas Bldg., Houston, Tex., has awarded the contract for design and construction of refinery expansion to E. B. Badger & Sons Co., 75 Pittsburgh St., Boston, Mass. Estimated cost $10,000,000

La., Lake Charles—Southern Alkali Corp., Lake Charles, has awarded the contract for additions to caustic and chlorine plants to Tellepson Construction Co., 1710 Telephone Rd., Houston, Tex., at $1,450,000. Owner will furnish materials to cost $1,750,000. Total estimated cost $3,200,000.

Miss., Brandon—Marquette Cement Co., c/o M. T. Reed Construction Co., 162 Millsaps Ave., Jackson, contractor, will construct a cement plant. Estimated cost will exceed $3,000,000

O., Marietta—Electro-Metallurgical Div. of Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, N. Y., has awarded the contract for improvements to its plant here to F. H. McGraw & Co., 51 East 42nd St., New York, N. Y. Estimated cost $250,000

O., Urbana—Liquid Carbonic Co., 3100 South Kedzie Ave., Chicago, has awarded the contract for a carbon dioxide plant to Walter Kidde Construction Co., 140 Cedar St., New York, N. Y. Estimated cost $1,000,000

Pa., Danville—Merck & Co., Inc., 1935 Kerrigan Rd., Rahway, N. J., has awarded the contract for an antibiotic unit here to Austin Co., 19 Rector St., New York, N. Y. Project will cost several million dollars

Pa., Philadelphia—Gulf Oil Corp., 30th St. and Penrose Ave., has awarded the contract for warehouse and shop building to Henry E. Baton, Inc., 1717 Sansom St., at $275,000

Pa., Philadelphia—Liquid Carbonic Corp., 3100 South Kedzie Ave., Chicago, Ill., has awarded the contract for a manufacturing plant, office and garage to Walter Kidde Constructors, 140 Cedar St., New York, N. Y., at $250,000

Pa., Philadelphia—National Drug Co., 4663 Stanton Ave., has awarded the contract for alterations and addition to its plant to Dobson & Co., 6027 Germantown Ave. Estimated cost will exceed $68,000

Pa., Philadelphia—Quaker City Rubber Co., c/o Nason & Cullen, contractors, 6522 Vine St., will construct a 1 story factory. Estimated cost $68,000

S. C., Rock Hill—Celanese Corp. of America, c/o Daniel Construction Co., contractor, 429 Main St., Greenville, will construct an addition to Olriver plant. Estimated cost will exceed $100,000

Tenn., Chattanooga—Cutter Laboratories, c/o Austin Co., contractor, 16112 Euclid Ave., Cleveland, O., will construct a manufacturing plant. Estimated cost $1,000,000

Tenn., Nashville—Clements Paper Co., c/o Boone Contracting Co., 3rd Natl. Bank Bldg., will construct a warehouse and office. Estimated cost $330,000

Tex., Abilene—Onyx Refining Co. will construct a platforming unit at its refinery here. Work will be done by force account. Estimated cost $600,000

Tex., Dallas—General Portland Cement Co., Republic Bank Bldg., will construct Unit #3 of its plant expansion. Work will be done by owners and sub-contracts. Estimated cost $450,000

Tex., Fort Worth—Premier Oil Refining Co., Mt. Olivet Rd., has awarded the contract for a catalytic refinery platforming unit to Universal Oil Products Co., 310 South Michigan St., Chicago, Ill. Estimated cost $250,000

Tex., Garwood—Superior Oil Co., Oil & Gas Bldg., Houston, will construct an injection unit. Work will be done by owners and subcontracts. Estimated cost $550,000

Tex., Houston—General Chemical Div. of Allied Chemical & Dye Corp., 3909 Capitol St., has awarded the contract for a warehouse to R. E. Sullivan, 1st. Natl Bank Bldg., at $86,116

Tex., Houston—Oil & Chemical Products, Inc., 2121 San Felipe Rd., has awarded the contract for 2000 bbl. distillation and treating unit to Delta Engineering Corp., 2121 San Felipe Rd. Estimated cost $475,000

Tex., Irving—Texas Panacalite Co., c/o S. W. Johnson, Irving, will construct a processing plant. Work will be done by owners and subcontractors. Estimated cost $100,000

W. Va., Chester—Harker Pottery Co., Chester, has awarded the contract for a sliphouse and glaze room to Potter Lumber & Supply Co., East Liverpool, O. Estimated cost $150,000

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Chemical & Metallurgical Engineering became Chemical Engineering in August 1946.

Chemical & Metallurgical Engineering was the successor to *Metallurgical & Chemical Engineering*, which, in turn, was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*. The magazine was originally founded as *Electrochemical Industry*.

McGRAW-HILL PUBLISHING COMPANY, INC., NEW YORK CITY

Volume 57

January to December, 1950

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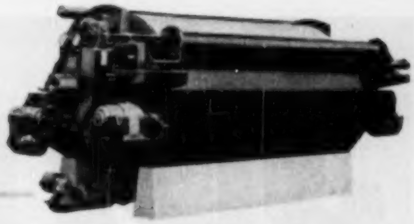

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Strength in VARIETY!

Yes, Oliver United's service to the process industries is strong and much of its strength is derived from the great variety of filter types its engineers can call upon when making recommendations . . . a variety of continuous vacuum, continuous pressure and batch pressure filters.

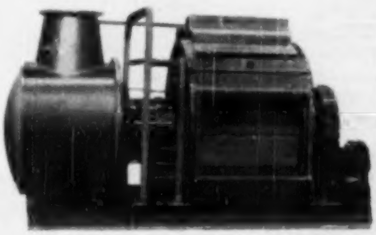
Take continuous vacuum filters, for example. There are the three time-honored "work horses" — Oliver Chemical, American and Dorrco Filters. Thousands are being operated today. They're well-proved.

But consider the extra value of Oliver United service when seeking the answer to your problem. Oliver United Engineers can also bring into the picture such outstanding special continuous vacuum filters as the Oliver Precoat, Panel, Horizontal and Top Feed Filters, each of which operates on an entirely different principle than any other.

When you are confronted with a filtration or clarification problem, keep in mind this variety of Oliver United Vacuum Type Filters. Also keep in mind that we have several distinctly different types of batch pressure and continuous pressure filters.

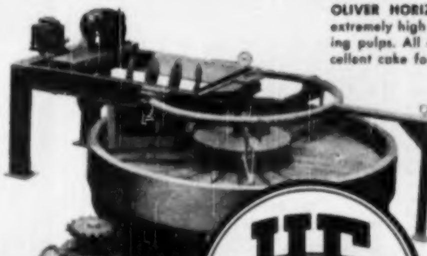
OLIVER PRECOAT FILTER . . . for pulps carrying hard-to-filter solids or low percentage solids or producing thin, sticky cakes. Fresh surface of precoat (filter aid) always in operation. Solids usually discarded.

OLIVER PANEL FILTER . . . for pulps similar to those handled by the Precoat Filter except solids can be saved. No filter aid or precoat is used. No wire winding on drum. Cloth laid on and changed in small sections, being caulked into division strip grooves.



OLIVER TOPFEED FILTER . . . best for certain commercial salts and other crystalline products requiring bone dryness or very low moisture content. Combines heat drying with mechanical dewatering. A variation of this type filter—the Oliver Synrub Filter—is being used extensively for washing and dewatering synthetic rubber "crumbs."

OLIVER HORIZONTAL FILTER . . . extremely high capacity on fast-filtering pulps. All operations visible. Excellent cake formation and washing.



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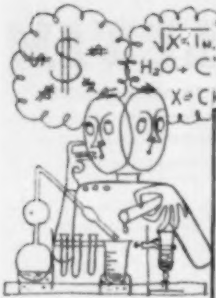

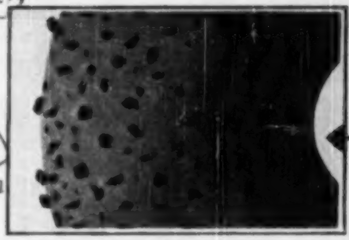

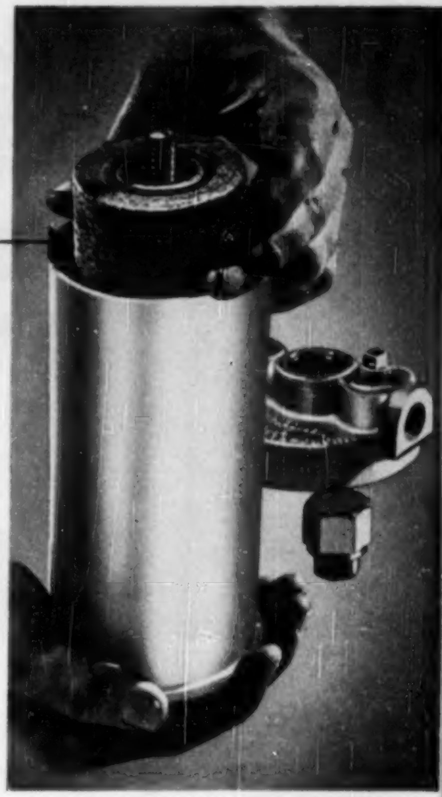

Before You Install an Expensive Filter . . .

see if

CUNO MICRO-KLEAN

won't do the job as well as you want

For a Fraction of the Cost

Most jobs of cleaning process fluids can be handled perfectly by the Cuno MICRO-KLEAN replaceable-cartridge type filter.

It's guaranteed to remove all solids larger than specified plus a large proportion down to 1 micron.

And see how much it saves in cost!

1. Initial cost is comparatively low.
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3. Greater dirt capacity means fewer cartridge changes.
4. Changing cartridge is quick—and clean.

Safest, surest cartridge-type filter!

1. Exclusive "graded density in depth" eliminates surface-loading, doubles dirt capacity.
2. No chance for fluid to by-pass cartridge—it's resinous-impregnated and polymerized against distortion, shrinkage, rupture or channeling.
3. Low pressure drop across filter.

Wide Range of Applications

Cuno MICRO-KLEAN filters come in varying densities . . . capacities from a few to more than 800 gpm . . . connections from ⅜ in. IPS to 6 in. flanged.

MICRO-KLEAN cartridges fit other makes; special lengths available for built-in installations.

No Fluid Is Better than Its Filtration

CUNO

Complete Line

Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC Micro-Klean • DISC-TYPE Auto-Klean
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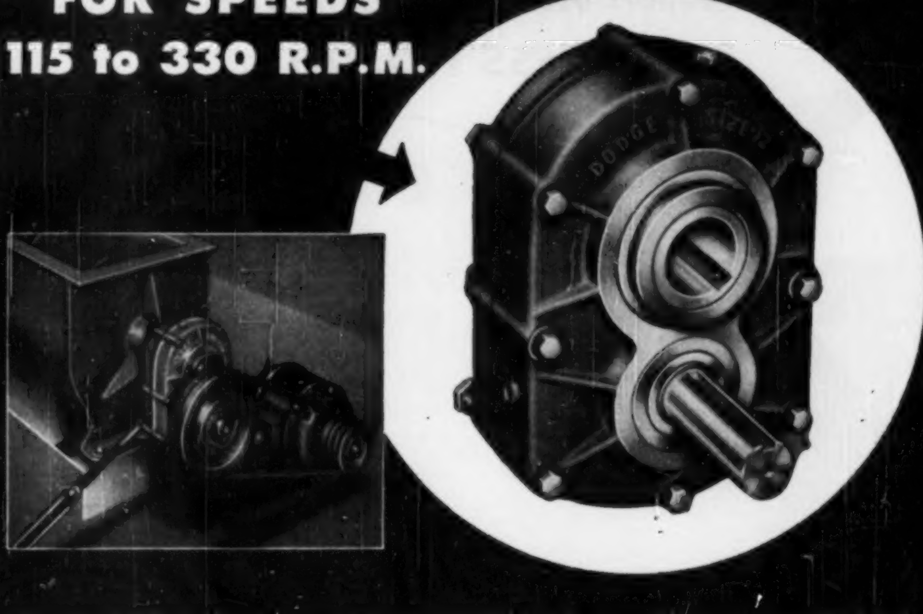
A TORQUE-ARM SPEED REDUCER FOR SPEEDS 115 to 330 R.P.M.



A SINGLE REDUCTION SHAFT-MOUNTED SPEED REDUCER now offered by Dodge provides a wholly new opportunity for important savings on drive reduction where requirements for output speeds range from 115 to 330 r. p. m.

This new SINGLE Reduction Torque-Arm Speed Reducer provides the same big advantages in this range that its companion, the Dodge Double Reduction Torque-Arm, has brought to the field of lower speeds. Practical and economical. Easier to install and much more flexible in its application than floor mounted reducers. This new Dodge Single Reduction Torque-Arm can be delivered right from your Distributor's stock. Simply give him your horsepower requirement, the desired speed and size of the shaft to be driven, and he will furnish this complete speed reducer package to fit your job accurately.

Write us for Bulletin A602 with full details.

★ Four sizes . . . all available from stock with stock product economy . . . with capacities up to 27 H. P. and developing output speeds from 115 to 330 r. p. m.

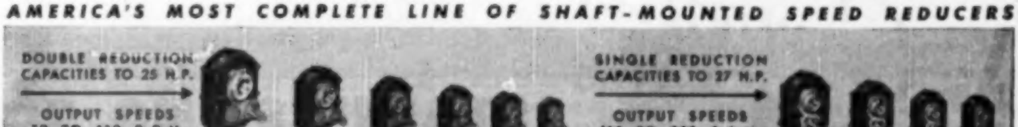
★ Torque-Arm, fastened to floor or any fixed object, anchors reducer unit. Turnbuckle provides fast, accurate adjustment of belt tension.

★ No special engineering required. No foundation to provide. No flexible couplings or sliding base. No "lining-up" difficulties. Unit is driven through any V-Belt Drive.

DODGE MANUFACTURING CORPORATION
200 Union Street, Mishawaka, Indiana

DODGE of Mishawaka, Ind.

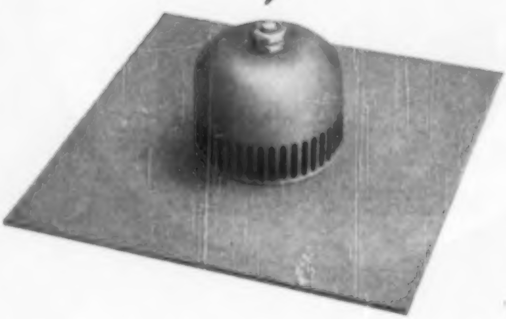
AMERICA'S MOST COMPLETE LINE OF SHAFT-MOUNTED SPEED REDUCERS



"MANY TIMES LONGER LIFE FOR EQUIPMENT ON H_2SO_4 JOBS"

report users of *Carpenter*

STAINLESS NO. 20 . . .



Fractionating tower parts can stay on the job longer *without replacement* when they are made from Carpenter Stainless No. 20.

Immersion heating unit with a sheath of Carpenter Stainless Tubing No. 20 stands up under almost continuous attack by *sulphuric, nitric, formic and other acids.*

In sulphonation or other processes which cause the formation of sulphuric, formic, acetic and other highly corrosive agents, Carpenter Stainless No. 20 is increasing equipment life from two to twenty times.

Similar in analysis to "Durimet 20" . . . Carpenter Stainless No. 20 is produced in these forms:

- Tubing & Pipe
- Sheet & Plate
- Fittings
- Fastenings

Bar stock, strip and *wire* are produced by the Carpenter mill at Reading, Pa.

New 16-Page Book of Technical Data

For complete information on No. 20 and the jobs it can do, write us a note on your company letterhead and ask for the new Carpenter Stainless No. 20 book. If you now have a typewritten bulletin about No. 20, replace it with this new book.

THE CARPENTER STEEL CO.
Alloy Tube Division • 111 Springfield Road • Union, N. J.

Export Department: Woolworth Bldg.
New York 7, N. Y. "CARSTEELCO"

Carpenter

STAINLESS NO. 20

Licensed under patents of The Duriron Co., Inc.

Engineered and installed by Gifford-Wood at a large Eastern brewery, this system handles corn, rice and malt from railroad cars at the rate of 2000 bu. per hour. It conveys materials to storage, whence it is removed by trucks to the brewhouse as needed. The entire unloading area is shed-enclosed for protection against the weather.

only through *Engineering*.. ..can *efficiency* be achieved

Economical, efficient **materials handling** is never a matter of luck. Each system must result from careful analysis of individual needs, must be developed only after every phase of the problem at hand has been thoroughly studied.

Gifford-Wood has been engineering materials handling systems for more than a century. Over these years, tremendous practical experience in the development of **materials handling systems** for every industry has been built up.

It enables G-W Engineers to go straight to the heart of your handling problem, to make recommendations based not on theory but on thorough understanding of your specific needs. It enables them to design for maximum economy by keeping operating and maintenance costs at the minimum.

To call upon **G-W Materials Handling Engineers** to survey your present methods of handling materials places you under no obligation. It may well prove to be a step toward higher profits through lower operating and maintenance costs.

When You Think of Materials Handling—Think of GIFFORD-WOOD Co.

Since 1814 HUDSON, NEW YORK

NEW YORK 17, N. Y.	ST. LOUIS 1, MO.	CHICAGO 6, ILL.
420 LEXINGTON AVE.	RAILWAY EXCHANGE BLDG.	565 W. WASHINGTON ST.

7177

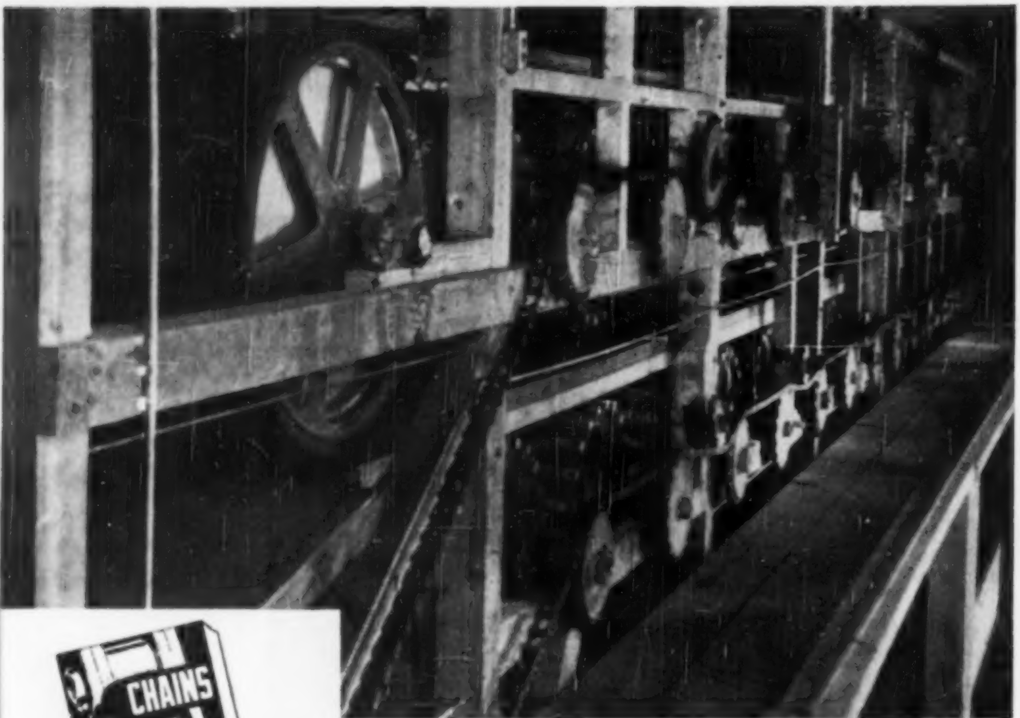
produces *all* these 10 basic chemicals

- **Sulphuric Acid**
- **Processed Sulphur**
- **Soda Ash**
- **Caustic Soda**
- **Bicarbonate of Soda**
- **Ammonia**
- **Ammonium Sulphate**
- **Nitrate of Soda**
- **Chlorine**
- **Sodium Chlorite**

The wide variety of Mathieson products meets the basic chemical demands of American industry—with the benefits of simplified, centralized purchasing, cooperative, economical traffic control, and chemicals of high purity standards. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Mathieson
CHEMICALS

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH



This **JEFFREY** Chain Catalog contains a wealth of chain data. In addition to an index of chains available, you will find Horse Power ratings for various chain types and sizes, how to figure number of links of chain in a drive, depth of sag in slack side of chain drive, tension in slack side of drive plus handy formulae and working loads as well as numerous other tables and dimensions. Write for this handy chain guide—Jeffrey Catalog No. 808—on your company letterhead. Do it TODAY.

JEFFREY *engineers chain for dependable drives*

● For example note the chain drive illustrated on this hop-picking machine. This is only one of hundreds of installations where Jeffrey Chain is handling the drive on vital production equipment in Industrial, Chemical and Food Plants . . . Mining and Construction operations of all types under all conditions.

If you are responsible for the design and development of equipment that requires dependable chain drives, it will pay you to investigate the Jeffrey line of chain. Jeffrey experience in building chain dates back more than 65 years and our engineers are available to work with you in determining the correct chain for your drive problem. Our new and improved Chain Department can take care of your requirements—*immediately.*

THE JEFFREY

Complete Line of Material Handling, Processing and Mining Equipment

MANUFACTURING COMPANY Established 1877

909 North Fourth St., Columbus 16, Ohio

Baltimore 2 · Beckley, W. Va. · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 2 · Cleveland 15 · Denver 2 · Detroit 13 · Harlan, Ky. · Houston 2 · Jacksonville 2 · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 1 · Salt Lake City 1 · Scranton 3

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

A NEW HIGH!

in Pressure Measurement

80,000 psi

and what it means to you . . .

Heavy-Duty Helical
50 to 80,000 psi

Helical
100 to 10,000 psi

Spiral
5 to 450 psi

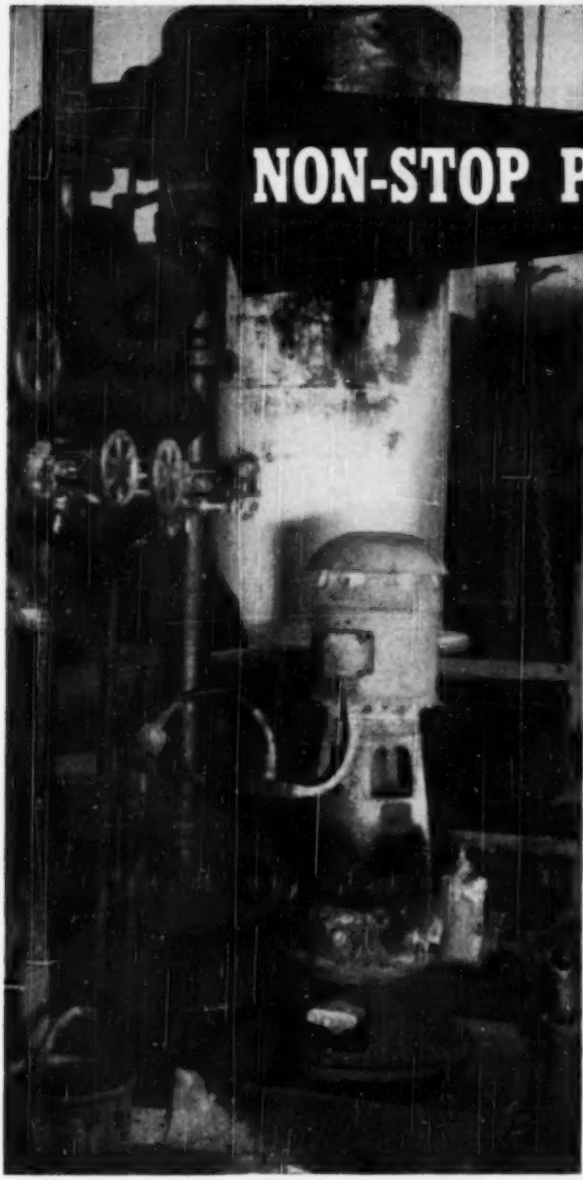
Whether or not you ever need accurate measurement of pressures in the super-range of 50,000 to 80,000 psi, this new, exclusive helical spring developed by Foxboro illustrates the advance engineering you will get in any Foxboro Pressure Instrument.

Ever since Foxboro introduced the helical pressure element with fixed center of rotation, industry has accepted the accuracy and performance of Foxboro Instruments as standards in the field. These standards may be your answer to immediate pressure problems.

Foxboro has the most complete line of pressure instruments available. You have a choice of rectangular or circular cases . . . spring elements in phosphor bronze, beryllium copper, or Type (316) Stainless Steel. For normal applications, the standard *spiral* and *helical* elements are standards of superior performance . . . rugged, fatigue-free, lastingly accurate. For the difficult, unusual jobs, the new *heavy-duty helical* offers radically new design utilizing the tough, corrosion-resistant properties of Type (316) Stainless Steel . . . particularly adapted to rapidly pulsating service from zero to full pressure . . . and to expanded ranges. Responsive and absolutely safe on pressures up to 80,000 psi. Other elements (not illustrated) include: *diaphragm*, 0-2" water to 0-5 psi; *bellows*, 0-5 psi to 0-25 psi; *absolute pressure bellows*, 0-4" mercury to 0-40 psi absolute.

This unequalled range of pressure elements, engineered to the highest standards, is your assurance of the best pressure instrument for any industrial application. **The Foxboro Co., 16 Neponset Avenue, Foxboro, Mass., U.S.A.**

FOXBORO
REG. U. S. PAT. OFF.
PRESSURE RECORDERS



NON-STOP PERFORMANCE

Pumping 98% sulphuric acid for 28,000 consecutive hours

After 28,000 hours of continuous operation, in which more than 125,000,000 gallons of 98% sulphuric acid had been handled, the Ohio plant that owns this LaBour self priming packingless Type G pump shut it down for inspection. Except for bearing lubrication, 28,000 hours continuous service was entirely without maintenance cost.

This record is no accident. For 27 years LaBour pumps have been built for dependable service. From basic design through strict metallurgical control of castings and on to final searching test before shipment, LaBour heads off the troubles that could interrupt chemical plant operations.

That's why the toughest jobs in the industry are done by LaBour pumps. It's also why *all* applicable jobs are given to LaBour in plants that watch true costs and know how to hold them down.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LaBOUR

THE LaBOUR COMPANY, INC. • Elkhart, Indiana, U.S.A.

BELTING BUILT FOR THE TOUGH JOBS

HEWITT-ROBINS Conveyor Belting gives longer service at less cost

When trouble comes by the ton . . . when you have heavy, abrasive, corrosive or hot materials to move, the easiest, most dependable and most economical way to do it is on a Hewitt-Robins Conveyor Belt.

For over half a century, the Hewitt Rubber Division of Hewitt-Robins Inc. has pioneered in making the right belt for every conveyor installation. Today, engineers the world over instinctively specify Maltese Cross® where the going is really tough, Ajax® for general service, and Conservo® for lighter applications and portable conveyors.

In Hewitt Rubber belting they get full protection against moisture, oils, flexing and ply-separation, as well as treatment against mildew. They get abrasion-resistance from extra-tough rubber covers, heavily textile-reinforced for maximum strength plus flexibility.

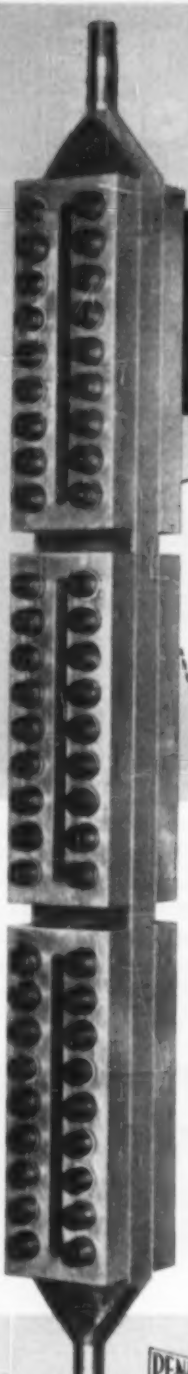
Engineers turn to Hewitt-Robins not only for belting but for entire belt conveyor systems. They know Hewitt-Robins is *the only firm able to accept complete responsibility.* For belting, address Hewitt Rubber Division, Buffalo 5, N. Y.; for machinery, Robins Conveyors Division, Passaic, N. J.; for engineering services, Robins Engineers Division, 157 Chambers Street, New York, N. Y.

HEWITT-ROBINS

CONVEYOR BELTING

HEWITT-ROBINS INCORPORATED

BELT CONVEYORS *(belting and machinery)* • BELT AND BUCKET ELEVATORS • CAR SHAKEOUTS • DEWATERIZERS • FEEDERS • FOAM RUBBER PRODUCTS • FOUNDRY SHAKEOUTS • INDUSTRIAL HOSE • MINE CONVEYORS • MOLDED RUBBER GOODS • RUBBERLOKT ROTARY WIRE BRUSHES • SCREEN CLOTH • SKIP HOISTS • STACKERS • TRANSMISSION BELTING • VIBRATING CONVEYORS, FEEDERS AND SCREENS



for operating pressures up to

10,000 psi

PENBERTHY transparent LIQUID LEVEL GAGES

Another PENBERTHY First

These gages were developed by Penberthy in answer to persistent demands from the process industries and various laboratories for a gage with UNOBSTRUCTED VISIBILITY at service pressure ratings up to 10,000 psi. They are tested to 15,000 psi. Temperature rating is 250° F dry gas . . . 300° F wet gas.

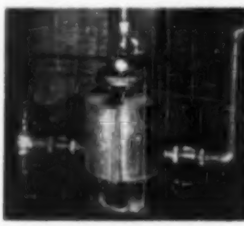
In addition to their value as liquid level indicators, these gages are useful as reaction chambers, equilibrium cells, high pressure manometers, etc.

The standard gage body containing the liquid chamber is forged carbon steel but stainless steels are available. Design is such that glass is entirely relieved of bolting pressure . . . providing a better seal and avoiding those stress concentrations which cause so much glass breakage.

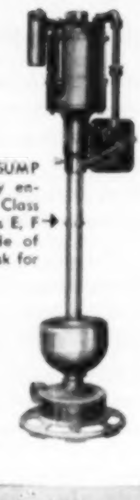
These Penberthy 10,000 psi gages are of proven dependability . . . they have been in field service for more than two years. Write us regarding your requirements.

Patent Applied for

OTHER PENBERTHY PRODUCTS



PENBERTHY CYCLING JET PUMPS. Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EXPLOSION-PROOF SUMP PUMPS. Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

PENBERTHY REFLEX GAGE. Empty space shows white, liquid shows black. You can't misread. Available in special alloys and now available for operating pressures up to 5,000 psi. Ask for Catalog 35.

PENBERTHY EJECTORS. A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Ask for Bulletin 5080.

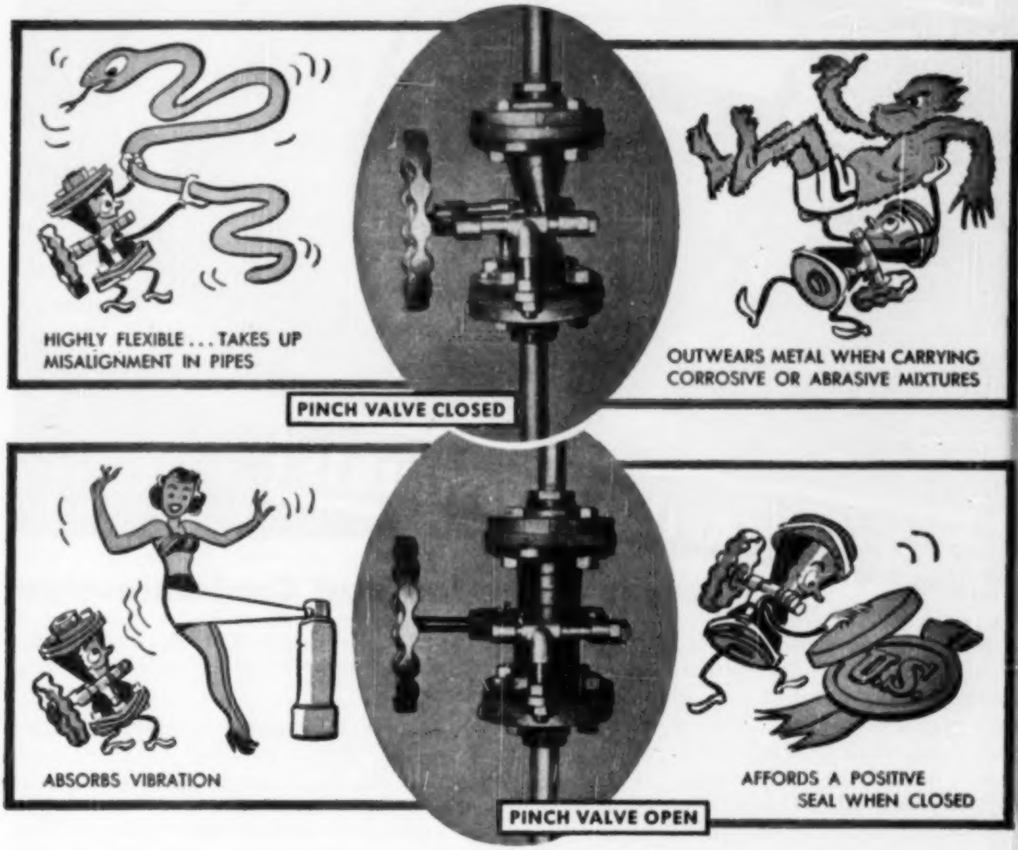
PENBERTHY ALSO MANUFACTURES A COMPLETE LINE OF LIQUID LEVEL GAGES IN BRONZE, IRON, STEEL AND ALLOYS

PENBERTHY INJECTOR COMPANY
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION
DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

4397

NEW PINCH VALVE SQUEEZES OUT *NEW* PRODUCTION ECONOMIES



FUNCTIONS—For use on pipe lines carrying abrasive, corrosive mixtures or raw chemicals. Eliminates "water hammer." Breaks up galvanic action in pipe lines. Can be operated partly open to control flow.

CONSTRUCTION—Abrasion-resistant or corrosion-resistant compounds, or neoprene for oil resistance, or butyl rubber for hign heat and severe acid conditions, or pure gum stock for food and beverage conveyance.

MAINTENANCE—Can be refitted to new valve bodies, reducing replacement costs.

No packing or repacking needed. Compact design, with mechanism, retaining rings and pinch valve body in a single unit—an advantage where space is limited.

Let this new valve reduce your operating costs. Write to address below.

PRODUCT OF

U.S. RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Quick Change

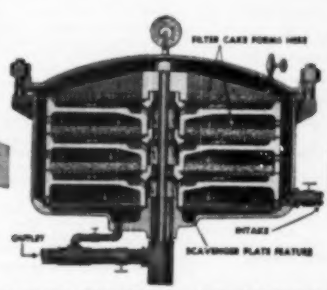
...of filter plates in SPARKLER FILTERS

means no shut-down for cleaning . . . The entire horizontal filter plate assembly in Sparkler Filters can be removed as a complete unit and a new assembly lowered into the filter in a few minutes without appreciable interruption in service. This quick change of plates is an exclusive Sparkler feature. No other filter has this unit assembly of plates for fast handling.

Another distinctive Sparkler feature is the firm, even support of the filter cake provided by the horizontal position of the plates. The filter cake will not crack or slip under variation in pressures or with intermittent operation of the filter. Any type of filter paper, cloth, screen, or filter media can be used without danger of breaking. There is no supporting strain on these materials.

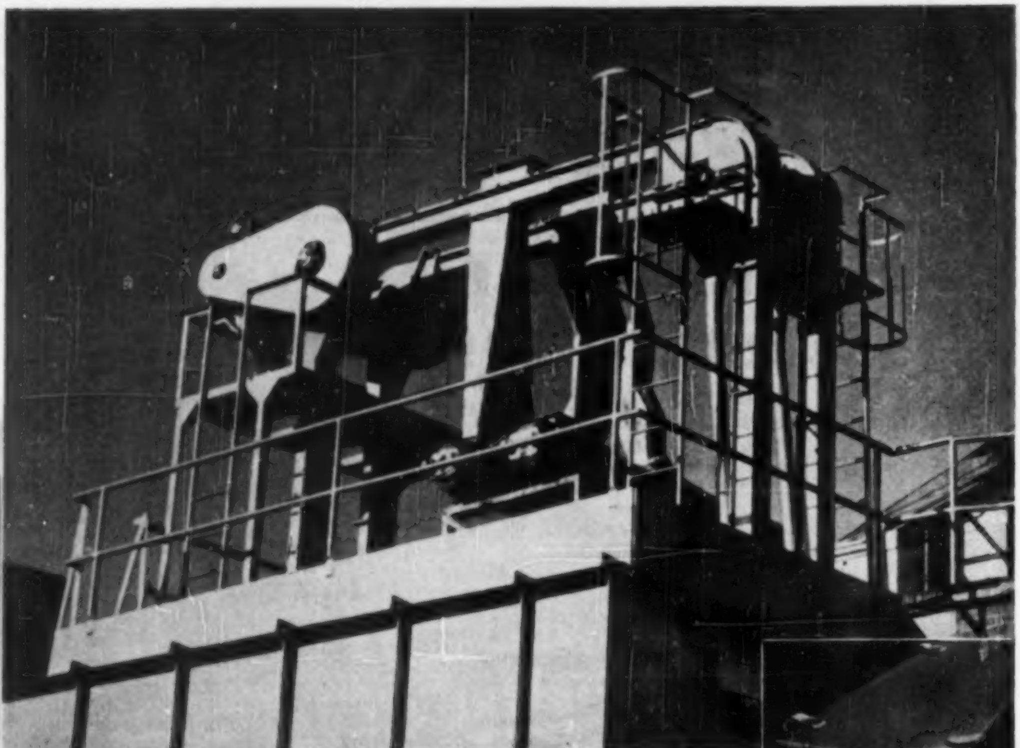
Sparkler filters take up little floor space, are completely enclosed, and are available in stainless steel, mild steel, rubber lined, steam or brine jacketed, monel, nickel, or bronze. They are capable of efficiently handling practically any kind of liquid from thin alcohols to varnishes and resins.

Sparkler service includes laboratory test runs and engineering of continuous flow filtration for production line installations. Write, giving details of your filtering problem.



SPARKLER MANUFACTURING CO.

MUNDELEIN, ILL.



MERCK & CO. Inc. (Stonewall Plant)
ELKTON, VIRGINIA

Two different raw materials are dumped into double loading hoppers on the first floor of the building. Two vertical, closed-circuit REDLER elevators with short 10-foot long, horizontal feed sections of casing under each hopper pick up materials and elevate them about 56 feet thru the roof of the building to a point where materials are transferred to two horizontal REDLER conveyors. One of the horizontal conveyors is 36 feet long and the other is 45 feet long. The horizontal REDLERS extend over large storage bins and discharge materials thru gate controlled chutes to storage. Upper half of elevators and all of horizontal conveyors are out-of-doors and weather-tight REDLER construction is a big advantage in protecting materials. REDLERS include the following advantages: (1) dust-tight and weather-tight casings protect materials and prevent loss, (2) compact design permits simple, space-saving installation.

Protecting Fine Materials from Hopper to Storage...

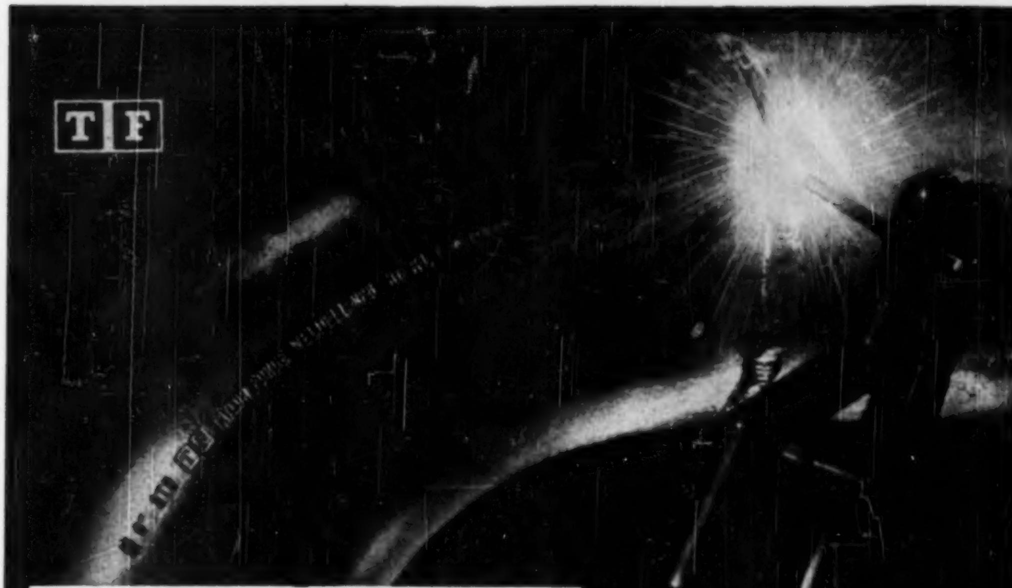
NO CONTAMINATION! NO SPILLAGE! NO ESCAPE! WITH REDLER CONVEYORS AND ELEVATORS!

Merck & Company, Inc., manufacturing chemists, required handling equipment to protect materials against contamination, to prevent loss by spillage and to guard against escape of materials into the atmosphere. S-A engineers designed and installed the simple, compact, space-saving REDLER Conveyor-elevator system pictured above, two-thirds of which is out-of-doors. It successfully meets every requirement—operates efficiently and economically, day-in and day-out! . . . If you have a material handling problem—if your equipment is less than demanded by today's high production, you will do well to draw upon the 50 years of practical, specialized experience available to you through the S-A engineering and manufacturing service. Write today, without obligation for complete information.

STEPHENS-ADAMSON MFG. CO.

3 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier* ...*better*. Coupon brings lots of facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • *General Offices & Works:* Chicago 90, Ill. (P.O. Box 485). *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif. *District Offices:* New York: 50 Church Street. Philadelphia: Broad Street Station Bldg. Pittsburgh: First National Bank Bldg. Chicago District Sales: 208 S. LaSalle Street. Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg. San Francisco: Russ Bldg.

Please send a copy of your welding fittings and forged steel flange catalog 484

Name________________

Position________________

Company________________

Street Address________________

City________ Zone____ State____

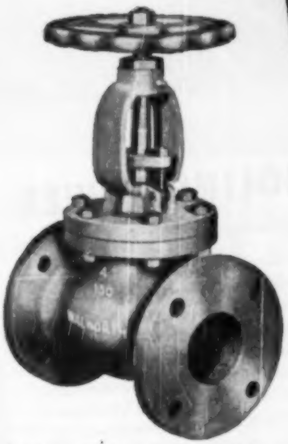
Mail to Taylor Forge & Pipe Works
P.O. Box 485, Chicago 90, Ill.

513-1250

Newly Designed Walworth Valves to combat corrosion

Walworth 150-pound Stainless Steel Gate Valve . . . available in sizes ½ to 3-inch, screwed; ½ to 12-inch, flanged.

Made of Stainless Steel
Monel · Nickel
Acid-resisting Bronze
Ni-resist



Walworth 150-pound Stainless Steel Globe Valve . . . available in sizes ½ to 3-inch, screwed; ½ to 6-inch, flanged.

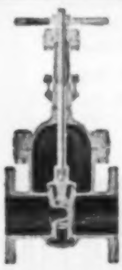
— ENGINEERED AND TESTED FOR TOUGH . . . HARD SERVICE

Walworth offers a comprehensive line of valves made of several cast stainless steels and special alloys for piping services where corrosion is a factor. These valves are available in Gate, Globe, Angle, Check, and Lubricated Plug types.

Gate, Globe and Angle Valves have outside screw and yoke construction, thus keeping the stem threads out of contact with the corrosive material in the line. They also have a two-piece bolted gland with ball-type gland follower to prevent binding the stem when packing bolts are tightened. Gland eye-bolts can be conveniently swung out of the way without danger of loss when the gland is lifted for repacking.

Gate Valves have taper seats with a unit consisting of two flat faced discs supported by a carrier on the end of the stem. The discs are of a proven ball-and-socket type. They are free to rotate and adjust themselves to the body seat angles, assuring tight seating with no possibility of sticking in any position.

For further information about Walworth's full line of corrosion-resistant valves, see your Walworth distributor.



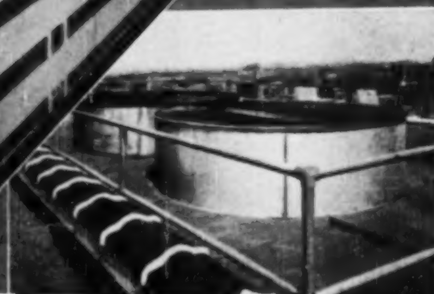
Sectional view of Walworth 300-pound Stainless Steel Gate Valve . . . available in sizes 2 to 6-inch, flanged.

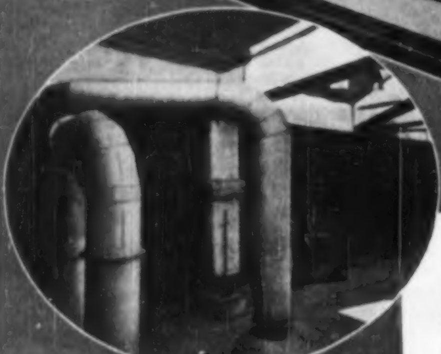
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD





This C. H. Wheeler water cooling tower serves the air conditioning system installed in the new plant of the Smith, Kline and French Laboratories, Philadelphia, Pa. Responsible for this new building and its air conditioning system were The Ballinger Co., architects; Riggs, Distler & Co., Inc., contractors; and Barclay, White & Co., builders. Carrier Corp. furnished the refrigeration machinery.

HIDDEN COOLING TOWER

Preserves Building Appearance; Still Does Its Job

To look at it you'd never believe there's a water cooling tower serving the air conditioning system for this modern pharmaceutical plant. Even after a second look, you won't find it because it is "camouflaged" into the very top of the building itself. The tower is ruggedly constructed of Construction Heart Grade of California Redwood with an outer casing of brick to match the building's architecture. This cooling tower carries the same guarantees as any other C. H. W. tower, including guaranteed fan horsepower and guaranteed water cooling performance—and yet with a harmonizing casing for appearance as well as safety to meet city fire regulations. When you need a cooling tower for air conditioning or any other application, consult C. H. Wheeler for a custom-built job. Write for descriptive literature.

C. H. WHEELER MANUFACTURING CO.
1808 Sedgley Avenue, Philadelphia 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

SINCE 1903

C.H. Wheeler
STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

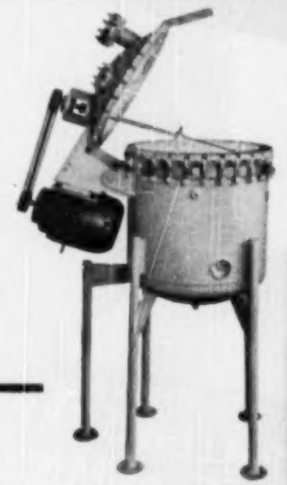

OUR CUSTOMER LIST
KEEPS ON GROWING
And well it might! The word gets around that a.c.f. has the equipment, the techniques and the resources to shoulder a major responsibility, and deliver the goods. The shops are tooled for hand and machine-welding under precision control, for X-ray inspection as required, and with the personal skills and experience of as expert a staff as exists anywhere. We'd be delighted to discuss adding your firm name to the customer list. Write for literature.
a.c.f.
FABRICATION

DESIGNS TO **YOUR** SPECIFICATIONS

(STANDARD OR TAILORED)

PRESSURE COOKER IS FAST AND EFFICIENT

This jacketed kettle was specially designed for a particular service by **p-k**'s engineering staff. It is a stainless steel jacketed unit with double propellers. The cover and integral agitator is counter-balanced for quick effortless opening . . . swings clear for easy loading and cleaning. This particular 250-gal. unit has No. 4 polish inside, a 5-hp. 4-speed explosion proof motor, is 42 in. in diameter and is built for 50-lb. pressure on both sides to meet ASME standards. It is a typical example of **p-k**'s ability to build units to meet specific requirements. Your inquiries about units to satisfy your own specific needs are invited.

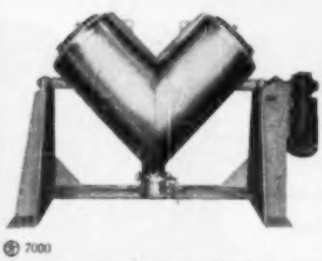


TYPE "D" EXCHANGER HEATS OR COOLS TO LOW TEMPERATURE DIFFERENCES

This simplified, expertly engineered exchanger insures maximum thermal efficiency in materials to meet individual specfications. Removable U-tube bundle elminates expansion strains. Capacity range: 95 to 101,000 gph.; Pressures: 0 to 100 psig. listed in new catalog—yours for the asking.

TWIN SHELL BLENDER INSURES A COMPLETE MIX

Operating on an entirely new principle, this twin-shell blender guarantees a rapid mix and thorough blend, regardless of particle sizes, shapes and densities. Shells are available in any required material, in capacities to 250 cu. ft. For test blends and laboratory use, **p-k** offers a unit in transparent plastic with 4- or 8-qt. working capacity. Write for Catalog 401.



7000

p-k *70 years of heat transfer experience assures you of superior design and construction*

- p-k Mixers
- p-k Coolers
- p-k Kettles
- p-k Agitators
- p-k Nitrators
- p-k Reboilers
- p-k Autoclaves
- p-k Condensers
- p-k Evaporators
- p-k Sulfonators
- p-k Brine Heaters
- p-k Brine Coolers
- p-k Freon Coolers
- p-k Soap Crutches
- p-k Ribbon Blenders
- p-k Fuel Oil Heaters
- p-k Vapor Condensers
- p-k Lube Oil Coolers
- p-k Lube Oil Heaters
- p-k Reaction Vessels
- p-k Instantaneous Heaters
- p-k Quenching Oil Coolers
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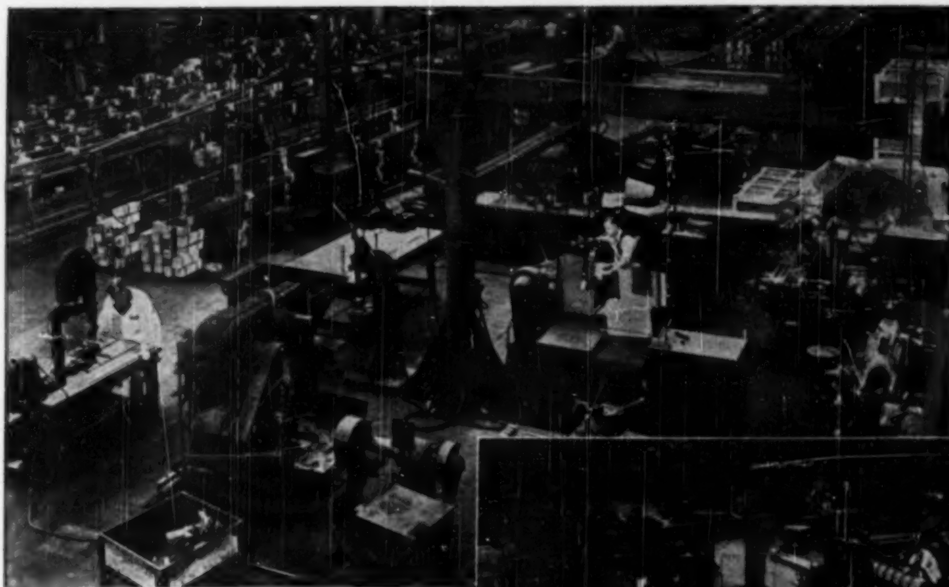

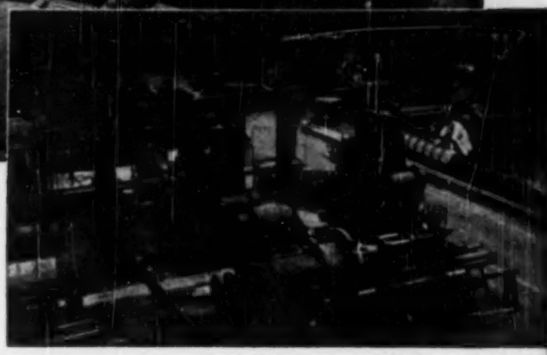

In every aspect of the A. O. Smith Heat Exchanger Plant you find the specialization that implements the A. O. Smith creed of the search for "A Better Way."

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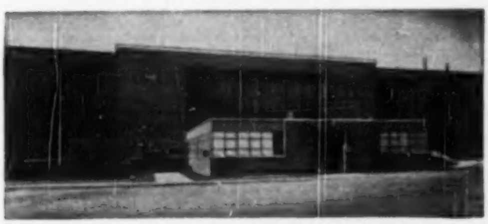

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Bulletin on SUPER REFRACTORIES by CARBORUNDUM

TRADE MARK

NO. 11 **DECEMBER, 1950**

Why is a Variety of Super Refractories Desirable?

A wide range of refractory properties is required in modern furnaces. Resistance to slags, spalling, cracking, mechanical abrasion, flame erosion, and high temperatures are needed. Chemical inertness, load carrying ability and high thermal conductivity are also called for. Light weight, high density, low permeability and insulating qualities are often required.

Obviously, no single super refractory can embrace all of these features. Therefore, a variety is needed in order to provide the best possible combination of features for each particular set of operating conditions.

The table below indicates only the major classes of super refractories by CARBORUNDUM. Each product class must necessarily consist in turn of many *types*. A silicon carbide refractory, for instance, may be the proper material for a job providing that certain of its properties can be enhanced. To best meet such requirements, a special *type* of CARBOFRAX silicon carbide refractory must be available.

In order to meet this wide range of demands The Carborundum Company has developed a large variety of super refractories. Today, more than 60 standard types of CARBOFRAX materials are available. Other product groups have been extended proportionally.

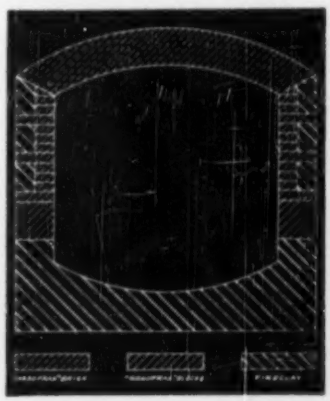
Physical Properties of Super Refractories by CARBORUNDUM (Trade Mark)

	CARBOFRAX Silicon Carbide	MULLFRAX Electric Furnace Mullite	MULLFRAX S Converted Kyanite	ALFRAX K Electrically Fused Alumina	ALFRAX B	ALFRAX BI
Heat Conductivity at 2300° F. in BTU/hr. sq. ft. and °F./in. of thickness	109 BTU	16 BTU	9 BTU	24 BTU	12 BTU	7 BTU
REFRACTORINESS PCE CONE	37-40	38-39	37-38	37-39	39-40	38-39
SPALLING RESISTANCE	High	High	High	Good	Good	Good
ABRASION RESISTANCE	High	Medium	Medium	High	Medium	Low
THERMAL EXPANSION (25° — 1400° C.)	.0000044	.0000059	.0000069	.0000074	.0000085	.0000086
MODULUS OF RUPTURE @ 2460° F. PSI	800-3125	100-250	175-475	100-1050	100-225	50-100
WEIGHT 9 IN. STRAIGHT	9.25 lbs.	9 lbs.	8 lbs.	10.1 lbs.	7.25 lbs.	4.8 lbs.

Twin Problems Here — Abrasion and Heat

It used to be necessary to patch the side walls of these coke fired forge heating furnaces every day and rebuild brickwork every two to three days. Used for heating caps to be welded on drilling bars, the sidewalls were subjected to 2700°-2800° F. along with considerable abrasion as parts hit the walls. However, since the installation of eight courses of CARBOFRAX silicon carbide brick in each side wall, patching is necessary now only once a month and rebuilding only after three to four months of continuous operation.

The right combination of properties of the CARBOFRAX brick used have best fulfilled these service requirements.



Two Types of Super Refractories Best Service Reverbatory Furnace

This is a cross-sectional view of a typical reverberatory type, rock wool furnace using super refractories by CARBORUNDUM to advantage.

To withstand the extreme corrosion encountered at the slag line, MONOFRAX K fused cast blocks are used in

Address all correspondence to: Dept. H-120, THE CARBORUNDUM COMPANY, Refractories Division, Perth Amboy, New Jersey

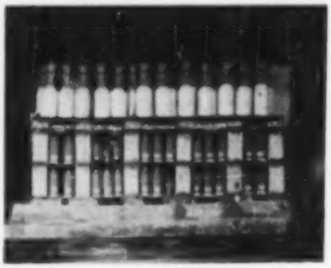
Continued on other side →

⟵ *Continued from other side*

this area. Being a fused cast high alumina product, this material is extremely dense, thus avoiding erosion by the basic charge. It is also highly refractory, having a fusion point of over 3500° F.

Above the MONOFRAX blocks, CARBOFRAX brick are used in the side walls and arch to withstand the extreme temperatures and cutting action of the flame. As there is no softening of the hard, dense CARBOFRAX brick, deformation of the walls is avoided — maintenance cost is minimized. Also, the high thermal conductivity of these brick is used to dissipate heat in certain areas.

As is apparent here, complex service conditions — even in one furnace — often demand a combination of super refractories to meet these needs.

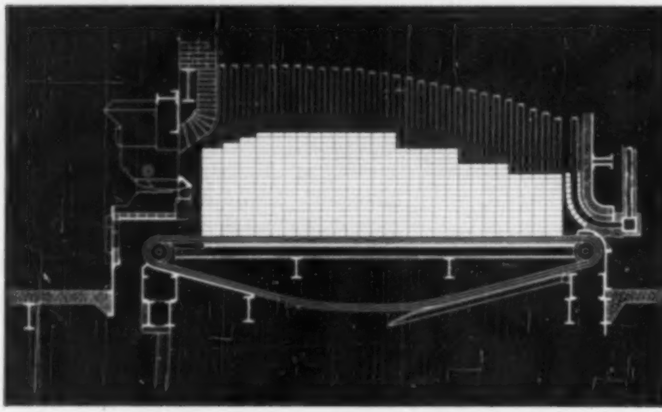


Ceramic Operation Demands Special Type Super Refractory

This is a typical car superstructure used by a manufacturer of electrical porcelains and insulators. The kiln is operated on a 48 hr. cycle at temperatures up to 2240° F. Due to the kiln construction, the furniture is subjected to severe heat shock at the entrance. Yet at the time of this picture, the CARBOFRAX setter tile had averaged 150 trips and were still in use. Moreover, in a 10 month operating period only two cars had to be rebuilt.

This excellent performance is attributed to the use of a special variety of CARBOFRAX tile. They have exceptional resistance to heat shock and can carry heavy loads at high temperatures. (Note that the tile are still straight and true.) Also, the high thermal conductivity of the thin section CARBOFRAX tile insures uniform burning of the ware, and reduces under- and overfiring losses. Ware sticking is avoided, too, since these tile remain free from boiling or blistering.

Regardless of the type of ceramic operation there is a super refractory by CARBORUNDUM with the right combination of special properties to give the most economic results.

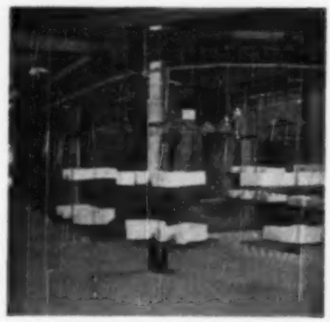


Job-Designed Super Refractory Aids Boiler Operation

Illustrated is a typical spreader stoker fired boiler equipped with water walls and a traveling grate. The water tubes are faced with CARBOFRAX silicon carbide blocks.

Here are the several advantages of using CARBOFRAX blocks: they protect the tubes from the abrasive action of the fuel and clinkers on the traveling grate; they protect the tubes from fuel impingement; they prevent slag from forming between the tubes and hampering operations; and they conduct the heat rapidly from the firebox to the water tubes. These operating benefits result from the specialized properties of CARBOFRAX blocks developed particularly for this type of service.

4 Different Super Refractories ▶ Improve Enameling Furnace Operation



To meet all of the conditions found in the various zones of this continuous enameling furnace, four types of super refractory are needed.

The side walls and hearth of the muffle are made of two varieties of CARBOFRAX silicon carbide tile. The lower thermal gradients through the muffle tile reduce the temperature heads. Thus, working temperatures are attained with less fuel input. With the greater temperature uniformity there are fewer rejects.

The support arches and pier facings are made from MULLFRAX electric furnace mullite material to best meet service conditions in the combustion chamber.

ALFRAX aluminum oxide side rail tile are used to support the muffle side walls. These tile are chemically inert and have more than enough strength to carry the side wall load.

By proper combination of these super refractories, the operator of this furnace has increased production and decreased fuel and maintenance costs. These exceptional results are made possible through a wide variety of super refractories by CARBORUNDUM from which to select.

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Efficiency

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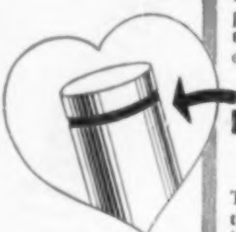

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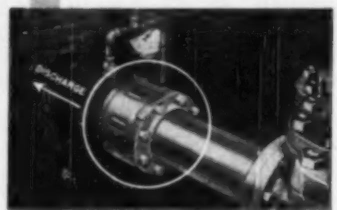
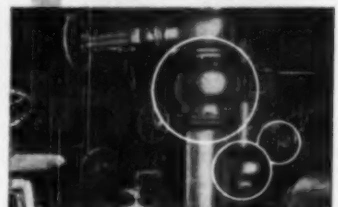
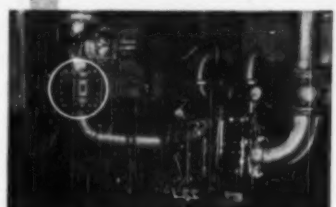


Waterworks. Service: Attachment at small end of 6" by 10" increaser.



Vertical and angular positioned valves protect high pressure pumps at the Longview Fibre Company.



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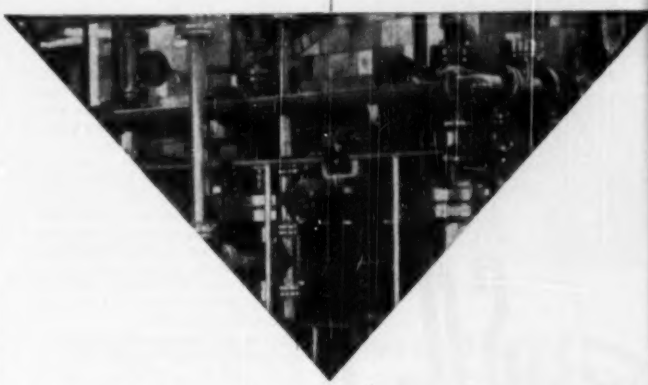

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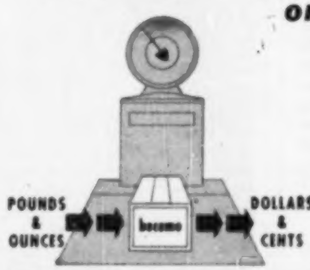

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PLASTICS DIVISION of midwestern company seeks Chief Engineer. Plant engineering included. Requires experience in process industry, preferably chemical. ME or CE degree. Salary open. Please send complete outline of experience. P-8364, Chemical Engineering.

PRODUCTION MANAGER wanted for an eastern chemical manufacturer. Experience required in modern film production or related fields. Responsibilities include industrial engineering, quality control warehousing, coordinating research and development. CE degree preferred. Salary commensurate with ability. Please send resume. P-8365, Chemical Engineering.

RESEARCH CHEMIST for midwestern paint manufacturer. Prefer Ph.D. with 5 years supervising industrial research. Should know resin technology. Will direct research dept. Send full resume. P-8397, Chemical Engineering.

SELLING OPPORTUNITY OFFERED

WANTED-SALES Engineer — Experienced in Chemical and Process Industries, for sales and service work. Excellent opportunity with old established machinery manufacturer. In reply give resume of education, experience, and current salary. Reply SW-8057, Chemical Engineering.

(Continued on page 360)

GOOD USED SURPLUS EQUIPMENT

FILTERS: 6 - 6' x 6' corrosion resistant (cast iron construction) Oliver Drum type Vacuum Filters with auxiliary equipment.

POWER PLANT: 3 - 500 HP B & W Sterling type Boilers, complete aux. equip. Also Waste Heat Boilers same type. 1250 KVA 440 V. Generator direct connected G.E. Steam Turbine, switch board and aux. equip. Also steam driven C.P. Air Compressor size 12" x 14" x 11".

EVAPORATING & CRYSTALIZING PLANT: 7 Swenson Calandria type Evaporators and one Vacuum Crystalizer, two stage. Complete plant with pumps, piping, valves, etc.

PUMPS: 15 - 6" Allen Sherman Hoff rubber lined with splashproof motors. Also numerous Bingham and other motor driven process pumps.

MISC: 3 - S & A Pan Conveyors — Blowers & Exhausters — Large dia. Thickener mechanisms — Cottrell Precipitators and numerous other items.

Equipment at this plant operated comparatively short time.

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POSITIONS WANTED

MECHANICAL ENGINEER, 38. Surveying and supervising project work for a large multi-plant manufacturer of chemicals, usually co-ordinating between plant and engineering. Broad background in steel, stainless and other anti-corrosion equipment design and selection based on a clear understanding of maintenance and operating costs. 10 years with present employer. Previously in chemical maintenance or equipment design and fabrication. Reasonable salary for interesting responsible position in chemical, paper, or allied industries. Member A.S.M.E. Registered. An Eastern location is preferred. Please write PW-8288, Chemical Engineering.

CHEMICAL ENGINEER: Four years Army Engineer, four years own agricultural chemical business. Research, development, operation, management, sales experience. Desire position combining research and production or research and sales, with established progressive concern. PW-8294, Chemical Engineering.

CHEMIST-ANALYST. Mature. Active. Thoroughly competent, analysis of metals, ores, silicates, fuel, gas, water, industrial chemicals. Now employed; desires position, charge of laboratory. Eastern location. PW-8307, Chemical Engineering.

MECHANICAL ENGINEER - Veteran 29, B.S.M.E., PE. 7 years Gas and NH_3 plant operation. $3\frac{1}{2}$ years plant designing. Experience in pumps, piping, gas plant equipment, medium size boiler plants and control equipment. Desires responsible engineering or operating position in South or Southwest. PW-8368, Chemical Engineering.

CHEMICAL ENGINEER, 30, graduate, PE nine years extensive supervisory experience in layout, design, construction, operation and maintenance of vegetable oil and chemical plants. Desires responsible position where exceptional engineering ability and wide experience are required. Northwest or Midwest location preferred, but not necessary. PW-8387, Chemical Engineering.

CHEMICAL ENGINEER with 17 years experience in production, plant management, etc. now on staff of a chemical company, desires position in production management. PW-8433, Chemical Engineering.

SELLING OPPORTUNITY WANTED

REPRESENTATION WANTED. Commission basis. Sales Engineer—national background successful sales experience to process industries, wishes to confine efforts Delaware, Maryland, D. C., Eastern Penna., South New Jersey, and represent builder of fabricated, pressure vessels, tanks, kettles, mixers, exchangers, or kindred product. Home and office Wilmington, Del. RA-8300, Chemical Engineering.

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FILTERS

4—SWEETLAND Filters—No. 12 with 36 steel, bronze or Monel leaves; also #5.

1—ALUMINUM Sperry, 30" x 30", Plate and Frame, 45

1—4' dia. x 5' EIMCO Vacuum FILTER, all steel.

1—48" COPPER RECTIFYING COLUMN with 40 bubble cap plates.

1—36" CAST IRON RECTIFYING COLUMN, with bubble cap plates.

1—Munson Rotary type 2, 60" dia. drum, conical ends, V-belt to 5 HP, AC motor.

6—25,000 gallon HORIZONTAL STEEL STORAGE TANKS, ⅜" with 12' high supports.

1—#2W MIKRO-PULVERIZER, with 10 HP motor, stand, etc.

1—Stokes 79-80 semi-auto. TUBE FILLER, CLOSER, CLIPPER.

1—24" Tolhurst CENTRIFUGAL, rubber-covered perforated basket.

60—40, 60, 80, 100, 150 gal. ALUMINUM JACKETED KETTLES, pressure tested.

1—J. H. Day Steam Jacketed ALUMINUM Horiz. 1,000# DRY POWDER MIXER.

1—160 gal. Buhrstone-lined PEBBLE MILL, with expl. proof motor.

1—Self-adjusting carton stop and bottom GLUER-COMPRESSION UNIT.

1—Complete DRY ICE PLANT, capacity 50 tons per day, steam driven.

6—25,000 gal. Horizontal STEEL STORAGE TANKS, ⅜", with 12' high steel supports.

1—Baker Perkins 100 gal. Stainless Steel Vacuum Mixer.

2—#0000 RAYMOND PULVERIZERS, also selection other sizes and 30 Hammer Mills of various makes.

1—#1 BANBURY MIXER, chrome plated rotors, drive, 40 HP motor.

5—Day Roball Sifters, #71, 40" x 84", STAINLESS STEEL, Single Deck, motor driven.

2—2,500 lb. Horizontal Ribbon Type POWDER MIXERS.

1—500 gal. PATTERSON HIGH CHROME MANGANESE BALL MILL, 5' x 6', jacketed, with drive and motor.

1—1600 gal. STEEL KETTLE, jack., open top, agit., 7' x 5'6".

10—BAKER PERKINS MIXERS, Jacketed and Unjacketed, 5 gal., 9 gal., 20, 50, 100, 150, 200 gallon.

1—#OA 18" RAYMOND SCREEN MILL.

DRYERS

3—Rotary Vacuum Dryers: 5' x 33' and 5' x 25' Devine; 4 x 20' #59-C Stokes; 3 x 15' #59-B Stokes; each complete with auxiliary equipment.

4—Vacuum Shelf Dryers: Devine 10—40" x 43" shelves; #11 Devine, 17—40 x 43" shelves; Devine with 18—59" x 78" shelves; Devine #23 with 13—59 x 78" shelves; 29—40 x 43" extra welded vacuum dryer shelves.

1—Buffalo Vacuum Drum Dryer, double rolls, each 42" dia. x 120", complete. Also 5' x 10'6" Devine with single bronze drum.

9—Double Drum Atmospheric Dryers: 28 x 60", 36 x 81" Black & Clawson; 32 x 72", 32 x 90", 32 x 100", 42 x 90", 42 x 100" Buffalo.

8—Single Drum Atmospheric Dryers: Two UNUSED 48" x 48" Goslin-Birmingham; 48 x 40, 5 x 12' Buffalo; 4 x 5' chrome clad; 4 x 9' Albright-Nell.

1—6' x 4' Flaker, chrome-plated, m.d.

2—6' x 27" Davenport Rotary Steam Tube Dryers, each with vari-speed reducer and motor, etc.

12—Rotary Dryers: 3'6" x 24' Aluminum; 4' x 30' Monel; 5'4" x 40' Stainless Steel; 2' x 15', 5' x 24', 5' x 30', 5' x 50', 6' x 60', 8' x 60', 9' x 85', 11'6" x 120'. Also ROTARY KILNS up to 9'6" x 250'.

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1—Tolhurst 26" suspended, steel
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2—Bird 36"x50" solid bowl, Continuous rubber-covered
1—Bird Solid Bowl Continuous 24"x70"
1—Sharples #16V, Stainless
3—Sharples #6, Steel
1—DeLaval Separator Type AC-VO

EVAPORATORS

3—Triple Effect, cast iron body, copper tubes, 13000, 8500, 5400 sq. ft.
7—Vacuum Pans 3 to 10' diameter, copper and steel
3—Stainless Steel Vacuum Pans, 4', 3', 6'

KETTLES—TANKS

10—Stainless 20 to 500 gal., jacketed
40—Steel Tanks Horizontal & Vertical, from 2000 to 650,000 gals.
2—Buflovak 6' dia. Crystallizers.
2—2'x15' jacketed Crystallizers.
25—Pfaudler Sectional glass-lined Tanks, 7500 gal., 8250 gal.
3—Pfaudler 800 gal. glass-lined agitated Tanks
1—200 gal. Stainless jktd agitated Kettle
1—Stainless Steel Tank, Hor. 3500 gal.
6—Pfaudler 1000 to 3500 gal. jktd glass-lined Mixing Tanks

ROTARY KILNS AND DRYERS

1—Vulcan 10'x150', 3/4" kiln
2—Vulcan 8'x125', 3/4" kiln
2—Link Belt, 7'x45', 1/2" Kiln
1—6'x48'8" Rotary Dryer, 1/4" shell, 1/16" monel
2—Ruggles-Cole 6'x40' S.S. Rotary Tube Dryers.
1—Monarch Rotary Dryer 4'x30'
3—Vulcan Rotary Dryers 8'x85', 4'x 22', 3'x40'
4—Louisville Rotary Steam Tube Dryers, 6'x50', 6'x25', 50"x20'
1—Adt 5'x35' Rotary Steam Tube Dryer

FILTERS

3—Valles #48 Pressure Filters, 31 leaves
6—Sweetland #12, 36 monel leaves
1—Sweetland #10 Filter, 33 stainless leaves
3—Sweetland #2, all stainless
6—Oliver Rotary 11'6"x18', 8'x12', 6'x8', 8'x8', 3'x4', 3'x2'
1—Swenson Rotary 4'x5'
2—Sperry 36"x36" Recessed, 50 chambers
1—Sperry 42"x42", P&F, 32 chambers
2—Sperry 30"x30", P&F, 30 chambers
1—Sperry Aluminum 30"x30", P&F, 26 chambers, with hydraulic closure
2—Shriver 24"x24" Recessed, 30 chambers
1—Shriver 18"x18" P&F, 34 chambers
2—Shriver 12"x12" P&F, 12 chambers
10—Shriver Skeletons, 18" to 42"
1—Niagara #85 Stainless Filter

LIQUIDATION SPECIALS

1—Raymond 3-Roll High Side Mill
1—Link Belt 5'x20' Roto Louvre Dryer
2—Sweetland #12 Monel Leaves
1—Sweetland #10 with 33 stainless leaves
2—Valles #48 Rotary Pressure Filters
1—Oliver Filter 5'4"x8'
3—Oliver Filters 11'6"x18'
30—Centrifugal Pumps 1½" to 8" discharge
5—Redler 17" Conveyors.
3—Link Belt 12"x12' Pug Mills
1—Rotary Dryer 6'x48'8" monel lined
1—Milton Roy Proportioneer Pump 10.8 gpm, Hastelloy
3—Dorr Thickeners mechanisms
300'—Link Belt Screw Conveyors
1—Simpson #1½ Intensive Mixer
2—Rotary Dryers 4'x20', 3'x30'
2—Bird 48" Centrifugals, m.d.
3—Pfaudler 800 gal. glass-lined Mixing Tanks.
2—Stainless 300-gal. jacketed agitated Kettles.
2—Pebble Mills 5'x6', 4'x5'
1—Sperry 30"x30" Aluminum Filter Press
4—Worthington Vacuum Pumps 800 cfm
2—Link Belt 7'x45' Rotary Kilns
1—Buflovak 42"x120" Double Drum Dryer
1—B&C 36"x84" Double Drum Dryer
1—Pfaudler 1500 gal. Hor. Tank
1—Pfaudler 2500 gal. S.S. Tank
1—Niagara #85 Stainless Filter
1—Eimco 8'x8' Rotary Filter
1—Buflovak 3'x15' Rotary Vac. Dryer

Send for details

DRYERS—VACUUM AND ATMOSPHERIC

4—Stokes & Buffalo Rotary Vacuum, 18"x 42", 30"x8', 3'x15', 5'x30'.
2—Stokes Vacuum Shelf, 16 shelves, 42"x42"
1—Devine Vacuum Shelf, 13 shelves, 60"x 137"
2—Ross Eng. 2-truck Atmospheric steam heated, 500 sq.ft. drying surface
5—Atmospheric Double Drum Dryers, 42"x 120", 32"x100", 32"x80", 36"x84", 30"x32"
5—Single Drum Atmospheric, 5'x12', 4'x12', 4'x8', 4'x6'.
2—Devine 5'x12' Vacuum Drum

PULVERIZERS AND MILLS

2—Ball & Jewell Rotary Cutters #2, #2½
2—Farrel 6"x12", 2-Roll Laboratory Mill
3—Raymond 5-Roll, 4-Roll, 3-Roll
1—Raymond #0000 Imp. Mill, 3' mechanical separator
2—Abbe 36"x42" porcelain Pebble Mills
2—Rodgers 3'x4', 2'x3' Pebble Mills
1—Patterson 3'x10' Steel Tube Mill, md
3—Mikro Pulverizers, 4TH, 2DH, 1SH
3—Colloid Mills, 9", 4" dia., S.S.
1—International 5'x8' porcelain Pebble Mill
1—Patterson 4'x5 porcelain Pebble Mill
1—Williams 20"x18" Hammer Mill
4—Hardinge Mills 8'x22", 6'x22", 3'x36", 4'8"x16", 5'x22"
3—Day 16"x40", 12"x30", 9"x24" 3-roll Mills
1—Raymond 6' Air Separator
1—#1½ Simpson Intensive Mixer

SCREENS

8—Rotex Screens 20"x48", 40"x56", 40"x84", 48"x120"
1—Robinson 40"x84" Stainless Single Deck

MIXERS—ALL TYPES

2—Baker Perkins 100 gal. Double Arm, sigma blade, steam jacketed.
2—Baker Perkins 20 and 9-gal. steam jacketed, Double Arm.
1—Baker Perkins 2 gal. S.S. Double Arm.
1—Day jacketed Double Arm, 100 gal.
10—Day, Robinson 100# to 2000# Powder.
1—Gruendler 2000# Steel Powder Mixer.
1—Munson 62 cu.ft. steel Conical Blender.
23—Electric Portable Agitators 1/4HP to 5HP.
20—Rodgers Powder Mixers, 100 to 5000#.
2—Ross, Porter 40-gal. Pony Mixers.
3—50-100 gal. Lead Mixers.
9—Day Wall Mixers, 150 gals.
2—Simpson Intensive Mixers #1½ & #0.

MISCELLANEOUS

4—Worthington Vacuum Pumps 800 cfm.
9— Stokes Tablet Machines, ½" to 3½".
2—#1 and Duo Anderson Expellers.
4—Nash Hytor Vacuum Pumps to 300 CFM.
6—Olivite 2½"x2" Centrifugal Pumps.
3—Rodgers, Stokes & Smith Powder Fillers.
1—Knapp #420 Automatic Carton Sealer.
30—Belt, Screw & Bucket Conveyors.

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Horizontal Pressure Tunnel, 7' x 7' x 50' complete.
Stainless Lined Pressure Vessel; 300 PSI; 50" x 19'.
Vacuum Autoclave 5' x 14'; Bolted head; 100 PSI.
Patterson Jacketed Autoclave: 300 PSI; 36" x 42".

COLLOID MILLS
Eppenbach, Premier, Charlotte, Marco, Cherry-Burrell, Manton Gaulin, Capo, Colloid Mills, Homogenizers, Viscolizers, mostly Stainless contact parts, equipped with motors up to 75 H.P.

DRYERS
J. P. Devine Rotary Vacuum Dryer, 4½' x 18' complete.
Pfaudler Glass Lined Rotary Dryer 24" x 120".
Hall Mobile Dehydrator or Rotary Multipass oil heated Dryer 7' x 16'.
Louisville Dryers; 3' x 20', 6' x 30'; gas and steam tube.
Buffalo Double Drum Dryers; 24" x 24", to 42" x 120".
Buffalo Chrome Plated Vac. Drum Dryer 5' x 12'.
Struthers Wells Stainless Steel Drum Dryer 5' x 10'.
Proctor & Schwartz Continuous Conveyor Type Single Pass Dryer with Stainless Belt; 60' long, 11' wide; 9 sections.
Proctor & Schwartz Continuous Apron Dryer; 7'6" x 16'6" x 42'6".
Koch Electric Ovens; 42" x 88" x66", double compartment.
3 Link Belt Roto-louvre Dryers; varying sizes.
Bowen Stainless Spray Dryers; Lab. size and 18' x 52'.
3 Continuous multipass Crystallizing Dryers with paddles 6" and 10" inside dia. 10' lengths.

EVAPORATORS, STILLS REACTORS, VACUUM PANS
Dover Steel 800 Gal. Evaporating Still 4' x 11'.
Buffalo Steel Evaporator 12' x 40' with barometric condenser.
2 Manistee Triple Effect Cast Iron 13' Evaporators.
Zahm & Nagel Continuous Evaporator; 2,500 lbs. per hour.
Alberger Karbate Hydrochloric Acid Recovery System.
Pfaudler 2,500 Gal. Glass Lined. Vac. Pan with Stainless Steel Coils.
Rosin Kettle 250 Gal. Stainless Jacketed agitated.
Lancaster 1,000 Gal. Jacketed Stainless Digester.
Dowtherm Jacketed agitated Kettle; 1,000 Gal. 57" x 7'.
Stainless Jacketed Pressure Vessel; 4' x 5'.
1,200 Gal. Stainless Reactor; 60"x93".
Two Stainless Horizontal Storage Tanks; 8' x 18' and oval 6' x 3' x 12' 8".
Zaremba Triple Effect Copper Evaporator; 220 sq. ft. each effect.
Mojonnier Copper Calandria type Vacuum Pan 6' x 16'.
Alberger Karbate Hydrochloric Acid Recovery System.

EXTRACTORS and CENTRIFUGALS
Tolhurst, Fletcher, American, Bird, Schaum & Uhlinger, Centrifugal Extractors in Stainless, Steel, Copper, etc., sizes up to 60" Baskets.
4 A. T. & M. Stainless Steel 60" Centrifugal Extractors with Vacuum and Pressure Tight covers; motorized.
Centrifugal Clarifiers and Separators by Sharples, DeLaval, latest types in Steel and other Non Corrosive metals.

FILTER PRESSES and FILTERS
Shriver and Sperry Cast Iron Plate & Frame Filter Presses, 12", 24", 30" and 36" open and closed delivery.
Sperry 36" Aluminum P.&F. Filter Presses closed delivery, washing.
Sweetland Leaf type pressure Filters Nos. 2, 5, 7 and 12.
Oliver United Dorrco type Rotary Vacuum Filter 6' x 3' with nickel contact parts.
2 Feinc String type Rotary Vacuum Filters; 8' 0" x 8' and 10' 6" x 16'.
Eimco Stainless Steel Drum Filter 4' x 6'.
Valley No. 40 Rotary Pressure Filter; 31 leaves; 350 sq. ft. area.
Large Stock of Alsop, Ertel, Bowser and industrial Filters of all types.

KETTLES
30 Brand New Stainless Steel Jacketed Kettles in STOCK; jacketed for 100# steam; 50 gal. to 500 gal.
4 Good used Stainless Steel Kettles, 80 gal., 100 gal.
22 Copper Steam Jacketed Kettles good used condition up to 300 Gal.
14 Steel Jacketed Kettles also cast iron up to 1,000 gal.

MILLS—Roller Mills
Roy Allen, Kent, Ross and Day Three Roller Mills, 4" x 8", 6" x 12", 9" x 24", 12" x 30" and 16 x 40" some with motors.
Lehman and Buhler Five Roller Mills.

Rubber Mills and Calendars
8 Rubber Mixing Mills by Birmingham, Farrell, Thropp, etc., from 36" to 60".
3 Three Roll Calendars of standard make: 12" x 30", 18" x 54" and 24" x 60".

Pulverizers, Grinders, Crushers, and Hammer Mills
8 Fitzpatrick Model D Stainless Steel Comminutors.
6 Mikro Pulverizers from Bantam to No. 4 some with motors.
FMC Model D80 Hammer Mill with Fan and Dust Collector.
Robinson Heavy Duty No. 4 Hammer Mill with 60 H.P. motor.
American Pulverizing Co. Ring Roll Crusher with 50 H.P. motor.
Sturtevant Jaw Crusher with 10" x 20" throat.
Sprout Waldron, Bauer and Robinson Double Runner Attrition Mills.
Raymond No. 45 Imp Mills with manganese hammers.
Simpson and Lancaster Muller Type Mixers; several sizes.
Williams, Gruendler, Stedman, Prater, Jay Bee and other heavy duty Mills with motors up to 125 H.P.

Pebble and Ball Mills
6 Buhrstone Lined Abbe Pebble Mills; 130 gal. 45" x 42" and 290 gal. 51" x 60".
2 Abbe Steel Jacketed Ball Mills; 15" x 21" and 32" x 30" with Balls and motors.
Steel Ball Mill 36" x 72" with 20 H.P. Motor and 3000# steel balls.
Hardinge Conical Roll Mill; 3' x 8"; other Hardinge Mills up to 8' x 30".

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Oliver Filter, 6' dia. x 3', standard dry vacuum salt type, complete with drive, and all accessories.

Copper Column, made by E. A. Badger & Sons, tunnel cap type, 78' dia. x approx. 35' high, complete with dephlegmator and condenser.

Stainless Steel Blender, double cone, approx. 20 drum capacity, with internal steam jacket, made by A. O. Smith Corp. complete with reductions, motors, drives, and all accessories.

Stainless Steel Briquetting Press, 14" rolls, made by Komare-Greaves, complete with all accessories, including stainless and chrome screw feeder equipped with automatic overloading device.

Hall & Jewell Cutters, one #2, and one #2½, complete with motors, and all electrical accessories. Many spare and extra parts included.

Dracco System, high vacuum pneumatic conveyor, 2 compartments with rotary lock type 3C, Nash #4 hy-tor vacuum pump, and motors.

Evaporator, single effect, J. P. Devine, 5' dia. x 17' high with vacuum receivers.

Condenser, C. H. Wheeler, 875 sq. ft., admiralty metal.

Stedman Hammer Mill, type "H", size 20" x 14" ring roll crusher.

Vertical Mixing Tanks, 9000 gal. capacity, with totally enclosed motors, Philie reducers, and Netco agitators. Other sizes from stock.

Stainless Steel Tanks, large stock from 150 gal. to 7200 gal.

Steel Hopper, 8' x 8' x 17' long body, 2—8' long cones, 10' x 10' x 15' long body, 1—7' long cone.

Agitators & Drives, large assortment from stock.

Steel Storage and Holding Tanks—7½' dia. x 30' x 5/16" with 3—5' domes on top . . . 8' dia. x 24' x ⅜" . . . 10' dia. x 30' x ⅜".

Acid or Caustic Storage Tanks, 7' dia. x 24' x ⅜" plate, 2—7' dia. x 25' x ⅜" plate with built in steam coils.

Raymond Mill, 5 roll, low side, R-6 base, with #11 exhauster.

Conveyors, pumps, aluminum tanks, glass lined tanks, stainless homogenizers, pasteurizers, coolers and many other items too numerous to list.

Candle Moulding Machines, special large stock, for export sale only.

All machinery available immediately from stock

We own what we advertise, we won't list your equipment! We'll buy it.

This is only a partial listing. Send inquiries to:

KAPLAN MACHINERY CO.
Tioga & Edgemont Streets Phila. 34, Pa.
Ph. Ne 4-1210

Fork Lift—Ross—7500 lb. capacity, gas engine, pneu. tires.

Jaw Crushers—7 x 9—5 x 12—10 x 18—12 x 26—48 x 60.

Rotary Kilns—54" x 30', Ruggles Coles 80" x 45' & 104" x 85'—XA dryers.

Pebble Mills 18' to 6' dia. also Hardinge 4½' x 16"; 6' x 22"; 6' x 48".

12" x 12" & 16" x 10" Sturtevant Crushing Rolls.

Baker-Perkins 750 gal. steam jacketed double sigma blade mixer. NEW.

LAWLER COMPANY
Durham Ave. & Lawler Pl.
Metuchen, N. J.

FOR SALE

Pump: 60 GPM. stain. steel, reciprocating.
Filter: Sweetland-12 24" leaves 4" c. c.
Dryer: Atmospheric Stokes, 4x6' single drum.
Steel Kettle: 150 gal. closed jacketed.
Filter: Oliver 3'x2' continuous.
Autoclave: 10 gal. Buflovak, cast iron.
Pebble Mills: 3'x6' Porter, 6x5' Patterson.
Mixer: Struthers-Wells 4x8' jack., closed.
Powder Mixers: 100 to 2000 lb. capacities.
Centrifugal: Rochester 30" suspended.
Press: Davenport #3A rotary grain.
Filter: Feinc vacuum 3'x1'.
Evaporator: Swenson single effect, 440 sq. ft.
Tanks: 10,000 gal. jacketed steel. (New).
Dough Mixers: Single and double arm.
Crusher: Dupps, 25 hp. motor.

WE BUY—WE SELL—WE LIST

LOEB EQUIPMENT SUPPLY CO.
1927 W. North Ave. Chicago 22, Ill.

QUICK DELIVERY ON GUARANTEED EQUIPMENT
Large Stock at our Brooklyn Warehouse & Shop

1—Dopp 1000 Gal. closed coil, Jack Kettle.
6—Rotary Dryers & Kilns 3'x30' to 8½'x130'.
6—Oil Expellers Anderson #1 & Duo.
1—Lehmann 4 roll W.C. 12"x30" steel Mill 20 H.P.
1—#00 Raymond Mill complete, 30 H.P.
6—French Oil Expellers 40 H.P., 3PF, M.D.
1—#7 Sweetland Filter bottom drainage leaves.
4—French Oil 400 Ton Linseed Presses.
4—New Pfaudler 65 gal. Glass Lined Kettles.
1—Devine #3 Vac. 4 Shelf Dryer Elec. Heated.
2—Hardinge Conical Ball Mills, 4½'x24", 3'x24".
7—Baker-Perkins heavy duty double arm Jack. Mixers 200, 100, 50, 9 & 0.7 gal.
1—Buffalo Vac. Drum Dryer 24"x20".
1—Badger 42" dia. Monel Bubble Cap Column.
6—Albright-Nell 4'x9' Atmos. Drum Dryers & Flakers. Also Gas Fired Dryers & Ovens.
8—Pony or Paste Mixers, 8, 15 & 40 gals.
5—Lehmann & Ross 3 roll Mills, 5"x8", 6"x14", 8"x22", 9"x32", 12"x30" & 16"x40". 9"x24" Roller Mill, 3 pr. high, corrugated.
7—Abbe & B&J Rotary Cutters 3 to 40 H.P.
3—Houchin 16"x30" 4 roll Granite Stone Mills.
6—Farrell 15"x36", 18"x45", 16"x40" & up. 2 roll motor driven mixing mills.
3—Rubber & Plastic Extruders 1½" to 6".
Stokes Jar & Can Filling Machine up to 5 gal.
2—Tyler #30 Jr., Hummer Screens 30" x 30".
8—Jack. Steel Kettles 50 to 1000 gals.
1—200 gal. lead lined Kettle.
1—Sperry 12" P&F Bronze Filter Press.
12—Sperry & Shriver 12", 18", 24", 30", 32", & 42" Iron & Wood Filter Presses.
Oliver Rotary Filters—Sweetland & Vallez Leaf.
1—Manton Stainless Steel Homogenizer.
10—Tolhurst 40" Suspended type Centrifugals, bottom discharge. Also 20" to 48".
1—Baker-Perkins Lab. Jack Mixer, 0.7 gal.
Rotary & Single Punch Tablet Machines ½" to 3".
12—Sharples Centrifuges #6A Stainless & #6.
Impreg. Unit Lab. or Pilot Plant. Other sizes.
New 6"x12" Lab. Mixing Mills & Calenders.
1—#00 Banbury Mixer. Other sizes to No. 3.
1—Century 2 HP, 4 speed vert. Mixer.
2—"Master" drum type Blenders 1000#, 5 HP.
10—Dry Spiral Mixers 50# to 2500#.
6—Rotex Sifters 20" x 30" to 40" x 84".
Atmos. Dryers or Ovens, Tray & Truck Type.
4—Stokes & Day Powder Filling Machines.
1—Gemco Jr. automatic vac. Bottle Filler.
Stainless, Alum. Copper & glass lined Kettles.
Stainless Steel & Glass lined Storage Tanks.
Mikro #1SH Pulverizers, 3 HP, and other sizes.
8—Hammer Mills 1 HP. to 50 HP.
Colloid Mills 1 to 50 HP.
2—Abbe Pebble Mills 6'x8' & 5'x4'. Also Jar Mills.
3—Stedman & Sprout-Waldron Crushers.
1—Sturtevant 30" Rock Emery Mill.
1—Robinson 10" Saw Tooth Crusher.
#00 & #0000 Raymond Mills. Also Low Side.
2—DeLaval Multiple Clarifiers, #300 & 301.
8—Simpson Intensive Mixers 0 to 3½.
1—Sprout-Waldron 18" Ball Bearing Attrition Mill, two 7½ HP. motors. Also other sizes.
2—Worthington 12"x12"x12" Vacuum Pumps.
4—Stokes vertical high Vac. Pumps.
6—Lead & Paste Mixers up to 300 gals.
10—Portable Elec. Mixers ⅛ to 3 HP.
1—Schutz O'Neill 20" Pulverizer; also #1.
2—Double Roll Crushers, 10" dia. x 14" face.
Soap Machinery for Toilet, Laundry, Chip, Liquid.
Hydr. Presses, Pumps & Accumulators. Boilers.
Injection Molding Machines

WE BUY YOUR SURPLUS MACHINERY—ONLY PARTIAL LISTING
WRITE FOR BULLETINS. PHONE: WORTH 2-5745

STEIN EQUIPMENT COMPANY

90 West Street, New York 6, N. Y. Cable: Machequip

$ for SALE

6—REACTORS, s/s 100 gal. type 347, agitated. NEW COST $11,860. Our Selling Price .... $1500 ea

1—STILL, 350 gal. Nickel, 18" aluminum column by 15' with aluminum condenser. NEW COST $8100. Our Selling Price $3250

1—FILTER PRESS, JACKETED, Shriver, 36", 416 sq. ft. NEW COST $6250. Our Selling Price $3250

1—VAC FILTER, Eimco 4' x 1', NEW. NEW COST $8400. Our Selling Price $4000

1—ROTARY CUTTER, Abbe #2 with 60 HP motor. NEW COST $5262. Our Selling Price $1875

1—TUBE MILL, Hardinge 4' x 14'6", granite lined. NEW COST $8500. Our Selling Price $3250

A FEW "BARGAINS" OF A FINE STOCK OF REAL EQUIPMENT

CHEMICAL PROCESS
MACHINERY CORPORATION
144 GRAND ST., NEW YORK 13, N. Y.

For Sale
GLASS LINED STEEL TANKS

Size 7'6" x 15'2"
Capacity 4410 Gallons
EXCELLENT CONDITION
MAY BE INSPECTED AT

THE BUNCHER CO.

835 Shore Ave., Pgh., Pa.
FAirfax 1-4950

FOR YOUR PROTECTION
Buy from a Reputable Dealer

SPECIAL ITEMS AVAILABLE

1—Tolhurst S.S. 48" Sus. Style Centrifuge, Perf. Basket, DMD.
1—ATM. Co. S.S. 26" Sus. Style Centrifuge, Solid Basket, DMD.
2—S.S. Condensors 50 and 65 Sq. Ft. Tubular.
3—W. & P. 100 gal. Stainless Steel Double Arm Mixers.
1—Buflovak Nickel Clad, Cast Iron Reactor, 150 gals.
1—Dopp 250 gal. Jack. Kettle, Double Motion Agitator.
1—Allis Chalmers 10' x 90' Dryer.
2—Vibrating Screens 2' x 7' Double Deck—Stainless Steel.
5—Steel Tanks 10,000 to 50,000 gals.
2—Stokes Tablet Presses "T" & "R".

Over 400 additional units available
Send for Latest Bulletins
We Buy Single Items to Complete Plants

Machinery Equipment Corp.

533 W. Broadway New York 12, N. Y.
GRamercy 5-6680

GOOD USED EQUIPMENT
AT LESS THAN YOU EXPECT TO PAY

Patterson Ball Mill 3½' x 4', Jktd., Chrome Manganese Steel Lined—10 HP motor
Bird Continuous Centrifuge 18" x 28", Solid Bowl, 316 S.S., 15 HP Exp. motor
Bird 40" suspended Centrifuge, plow & bottom dump, with motor
Patterson 8' x 8' Nickel Sprayed Reactor, Jktd. & Agtd., ASME code, 5 HP motor
Robinson Rotary S.S. Sifter, 20" x 30"
Buflovac 500 Gal. Autoclave 1000 PSI
Beach Russ Vac. Pumps motorized
B&J Rotary Cutters #1 - #3 & #1½ S.S. with 30 HP motor
Ross 12 x 30 Hy Speed 3 Roll Mill, late model, water cooled, 20 HP motor

WHAT HAVE YOU FOR SALE?

For BETTER BUYS & Service

Phone SOuth 8-4451—9264—8782

You Can BANK on the . . .

EQUIPMENT CLEARING HOUSE, INC.
289-10th ST., BKLYN 15, N. Y.

For Sale For Sale

1 Day 150 Gal. Brighton Mixer.
5 Pebble Mills 40 to 500 Gal.
10 Pony Mixers 8, 15 and 40 Gal.
3 Steel Roller ink and Paint Mills. 9" by 25"—12" by 30"—16" by 40".
1 Eppenbach Homo-Mixer.
1 Motor driven portable belt conveyor.
1 W & P Double-Armed Lab. Mixer.
10 8" Premier Colloid Mills, Water-Cooled.

SPECIALIZING IN REBUILT MACHINERY

IRVING BARCAN CO.

249 ORIENT AVE.
JERSEY CITY 5, N. J.
Phone—DElaware 3-4695

FOR SALE

6—VALLEZ Rotary Filters, Type 40, 41 leaves. Unused.
5—SPERRY FILTER PRESSES, 60 plates 30", Hydr. dos. Used.
1—GE TURBO-COMPRESSOR, 7000-9750 CFM at 22#. Used.

ROBERTS TRADING CO.
1411 Walnut St., Phila. 2, Pa. .... Ri 6-4881

Watch—
the *Searchlight Section*
for
Equipment Opportunities

CLASSIFIED ADVERTISING INDEX

ADVERTISERS IN THIS ISSUE

For more information about products of these advertisers, use Reader Service postcard in section following

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FOR CLASSIFIED INDEX SEE PAGE 369

Chemical Engineering Reader Service

HOW IT WORKS

Mail the postcard below. Before mailing, circle page numbers of items about which you want more details. Then write your name and address on other side of card and mail to us. Your requests will be forwarded to companies concerned, the answer coming direct to you.

TO MAKE IT HANDY

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EDITORIAL ITEMS

For more data, circle item number on postcard.

Circle desired item, fill in reverse side, tear out and mail

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Advertisements

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Card Expires March 15

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For more information about products of these advertisers, use Reader Service postcard in section following

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FOR CLASSIFIED INDEX
SEE PAGE 369

Chemical Engineering Reader Service

HOW IT WORKS

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For more data, circle item number on postcard.

• NEW PRODUCTS

• NEW EQUIPMENT

• NEW TECHNICAL LITERATURE

PRODUCTS ADVERTISED

For more data, circle item number on postcard.

Circle desired item, fill in reverse side, tear out and mail

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140A	142B	144D	146E	150A	152B	154D	157A	158C	162A	168A	276C	276J	276R	278G	278N	278U	280E	280K	280R
140B	142C	144E	148A	150B	152C	154E	157B	158D	162B	168B	276D	276K	278A	278H	278P	278V	280F	280L	280S
140C	142D	144F	148B	150C	152D	154F	157C	160A	162C	170A	276E	276L	278B	278I	278Q	280A	280G	280M	280T
141A	142E	146A	148C	150D	152E	156A	157D	160B	162D	170B	276F	276M	278C	278J	278R	280B	280H	280N	280U
141B	144A	146B	148D	150E	154A	156B	157E	160C	164A	170C	276G	276N	278D	278K	278S	280C	280I	280P	280V
141C	144B	146C	148E	150F	154B	156C	158A	161A	166A	276A	276H	276P	278E	278L	278T	280D	280J	280Q	280W
142A	144C	146D	148F	152A	154C	156D	158B	161B	166B	276B	276I	276Q	278F	278M					

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